The impact of ERP implementation on the financial performance of the firm

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The Impact of ERP Implementation on the Financial Performance of the Firm: an Empirical Study

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PROEFSCHRIFT

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Contents

Table of figures

Table of tables

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Chapter 1

Introduction

1.1. Objective of the chapter

This introductory chapter presents the background and motivation for the research reported in this thesis entitled "The impact of ERP implementation on the financial performance of the firm: An empirical study". We will first discuss ERP implementation in general, and then explain why it is interesting to focus on the context of Pakistan. From here, we develop the research questions, and we present the structure of the thesis.

1.2. Introduction

Firms have been implementing Enterprise Resource Planning (Gerpott & Paukert, 2013) system worldwide in an effort to strengthen their competitive stance in the market. ERP system include the set of hardware and generic software that ensure intra and inter organization integration if possible. ERP investment is one of the most important decisions made by firms because this can affect not only its competitive stance but also the wealth of shareholders. Cost reduction is regarded as the main purpose of ERP implementation. However, many studies treat ERP investment as a strategic move by firms to achieve competitive advantage. Anyway, attaining either of these goals will ultimately lead the adopters to improved financial performance. The question on benefits from the IT investment was raised by Solow in 1987 when he said that "you can see the computer age everywhere but in productivity statistics" a statement that came to be called productivity paradox. Following such statement by Solow, the PP has been probed empirically by many researchers with mixed results. Some of studies claim improved performance whereas other studies report no or negative impact of IT in post implementation period. (Hunton, Lippincott, & Reck, 2003) (Poston & Grabski, 2001), (Hunton et al., 2003), (Mithas, Tafti, Bardhan, & Goh, 2012), (de Andres, Lorca, & Emilio Labra, 2012) (Aral, Brynjolfsson, & Wu, 2008) etc. were among those who empirically tested the payoffs of ERP investment. All of these studies have been conducted in the developed world, this issue has rarely been explored in the developing world in general (Kossaï & Piget, 2014) and in Pakistan in particular (Muhammad, 2009). The question

is whether empirical evidence generated from industrialized countries cannot be generalized to the developing world. Furthermore, ERPs are designed and sold by western vendors hence, its embedded best practice represent the western process and culture (Amid, Moalagh, & Zare Ravasan, 2012). Rajapakse and Seddon (2005) argue that most of the ERPs software has been developed in technically and technologically advanced countries. Hence, it is assumed, while developing ERPs, that firms around the world are facing homogenous difficulties and challenges. However, the difficulties and challenges for firms in developing countries differ significantly from those confronted by firms in industrialized countries. As a result of such misalignment, the packages that ERPs offer to overcome difficulties and challenges in technologically advanced countries may not prove effective when adopted by firms in developing countries and companies tend to face ERPs implementation failure when they adopt foreign ERPs (Xue, Liang, Boulton, & Snyder, 2005). To address this issue we investigate the impact of ERPs implementation on firm performance in the developing country in general and in Pakistan in particular.

1.3. From IT/IS to ERP investments

In today's extremely dynamic business environment, the biggest challenge for the firm is to remain viable and competitive in the marketplace. The major part of extreme dynamism in the business environment has been injected by rapidly improving technology in general and information technology in particular that offers opportunities and threats. A few decades ago the IT could be treated as a tool to achieve competitive advantage but nowadays IT has changed from a tool for achieving competitive advantage into a necessity. A firm can't survive if it is not investing in computer (Oz, 2005). Teo, Wong, and Hui Chia (2000) argue that in order to remain competitive or even to survive, the information technology investment is necessary for offering innovative products and services more effectively. The investment in information technology has become inevitable for firms' survival in the long run (Gunasekaran, Love, Rahimi, & Miele, 2001). Stoel and Muhanna (2011) argue that for conducting business operations smoothly a firm mainly depends on IT.

1.4. Information Technology Definition

"IT investment, broadly defined, includes investments in both computers and telecommunications, and in related hardware, software, and services" (Dedrick, Gurbaxani, & Kraemer, 2003). IT investment is not the only tool for automation of current business processes but it plays a role of enabler which can bring desired organizational changes that can result in improved productivity (Dedrick et al., 2003).

The return on investments in IT can vary significantly among firms, sectors etc. which can be linked to differentiated management practices that allow the firm to bring organizational changes in accordance with the effective use of information technology (Dedrick et al., 2003). As different industries have varying business processes, management, operations, business cycles, decision-making style etc., the impact of IT can depend on a particular sector. Devaraj and Kohli (2003) recommend that in order to see the true effect of IT on organizational performance, the impact of particular IT application on specific industry should be assessed. Likewise, different IT investments have a different impact on organizational performance. Gattiker and Goodhue (2005) argue that studies conducted on the performance impact of IT have assessed collective IT investments instead of considering varying impact of the different type of information technology thus they suggest that better results may be achieved through focusing on particular information technology such as enterprise resource planning system (ERPs).

1.5. Enterprise Resource Planning

An ERP system can be defined as a set of commercial software packages and hardware that promise unified integration of information flow through all functional areas in a firm via providing them access to single database. The ERP software encompasses the best business practices which a firm can use to replace existing legacy systems. The ERP system vendors offer both a complete ERPs suite as well as ERP modules. The purpose behind breaking a complete ERPs suite into different modules can be multiple. ERP modules offers limited integration of information flow within a particular department/segment of a firm such as accounting and finance. ERP modules are cheaper than complete ERP suite. Limited diffusion of ERP module may allow the firms to experiment with the ERP effect

within a department before making a substantial investment in ERP complete suite at firm level. In the case of any failure, it can be easy for the firm to return to legacy systems for example and substantial post ERP module improvement can make it is easy for the firm to implement other ERP module or complete ERP suite at firm level.

The pressure developed by customers' desire to buy the best for spending the least has placed the firms into fierce competition to satisfy the customers, at least, better than competitors. Coping with such the dynamism in the environment, for example, is crucial for the firms to achieve sustainable competitive advantage thus the same goal can be adopted by firms to produce the desired quality and service by investing least. In persuasion of their goal firms began to invest in information technology to improve competitiveness and economic efficiency. Implementing ERP can be treated as an innovative strategic move which offers best industry practices, business process improvement, and intra-organization integration and inter-firm connection. ERP promotes embedded ERP theory by replacing disparately scattered work of legacy system with synchronized sets of organization-wide application (Hunton et al., 2003). The number of ERP adopters has been increasing rapidly with the passage of time (Zhang & Destech Publicat, 2014). Chaudhari and Ghone (2015) forecast that global ERP software revenue is expected to grow from $27.47 billion in 2014 to 41.69 billion in 2020 at 7.2 compound annual growth rate.

Ajit, Donker, and Patnaik (2014) reported evidence that the capital market reacts positively toward ERP implementation announcements therefore delivered added market value in term of increased share price to US firms and Contrary to this Bang, Kim, Lee, and Hwan (2002) investigated the impact of ERP implementation announcement on the market value of Korean firms by using event study. They found no positive capital market reaction. Furthermore, a marginally significant difference has been found between the market value of first mover and followers. Lee (2004) reported no impact of ERP announcement on stock price but they found a positive reaction by the stock market for small and medium enterprises. Hunton, McEwen, and Wier (2002) reported a significant increase in analysts' earnings forecast revision following ERP implementation announcements by US firms. The positive

response by analysts and stock markets indicate improved expected performance, however, the extent to which such expectations eventually realize remains unknown.

1.6. Potential purpose of ERP (modules of ERP) implementation

The purpose of ERP implementation can vary significantly from enterprise to enterprise. First, leading companies may implement ERP as an aggressive move to achieve and or sustain competitive advantage. Second, the intention for followers to implement ERP can be for lessening down the performance gap against leading firms in the industry. Final, survival can be the goal of late followers of ERP implementation. Therefore expecting same results from each of above ERP implementing firms' purposes can be illogical. Immediate imitation of ERP implementation by followers can reduce the overall expected benefits to leading adopters. Thus it will be important to explore and predict the possible purpose behind the ERP implementation.

Although the purpose behind ERP implementation matters in term of performance scope and vacuum for improvement for firms, the common goal irrespective to differential in purpose is performance improvement. Therefore we have taken the common goal of performance improvement as starting point.

1.7. ERP implementation in Pakistan: Contextual factors

ERP implementation faces different set requirements, advantages and challenges in developing countries such as Pakistan in the form of unique environment. Institutional settings such as Government policy about IT proliferation in the country, Tax regulation on import of new technology, Culture, religion, economic condition and other factors generate unique opportunities in these geography such as in Asia in general and Pakistan in a particular. Implementing ERP in Pakistan can offer certain advantage to adopters and or potential ERP adopting firms in diverse ways as discussed next

1.7.1. First movers among late followers in ERP investment

ERP system has been implemented by the firms around the globe, however Asia contributes only 9 percent of overall ERP revenue worldwide as compared to 66 and 22 percent in US and Europe respectively (Huang & Palvia, 2001). Although these numbers are 1.5 decades old they are useful in determining the extent to which Asia, with largest number of countries, is lagging far behind the

developed world in term of ERP adoption. The major portion of that 9 percent ERP revenue from Asia could be contributed by the developed Asian countries such as Japan, Singapore, Hong Kong etc. Thus it is easy to estimate that the number of ERP adopters in developing countries has been very low. However the economic growth in developing countries in Asia and other contents are hot target for major ERP vendors.

Pakistan is an Asian developing country with 62,343 registered firms in 2012 (Business, 2012). ERP implementation is in its infancy in Pakistan where less than one percent of the total number of firms registered in country in 2012 have implemented ERP. Early ERP adopters among late followers in developing country such as in Pakistan can offer dual advantages of enjoying simultaneously the benefits of leaders as well as late followers because Pakistan adopters are leaders as compared to non-adopters in Pakistan and a late follower as compared to adopters in developed world. On the one side, ERP adoption in Pakistan can provide first mover advantages. On the other side, lagging far behind in ERP implementation allow the Pakistani firms to have late followers' benefits such as: first, updated ERP software which may be incorporated the lessons learnt from ERP failure and insights from customer feedback along with additional requirements identified during and after ERP implementation in developed world. Second, rapidly declining price of hardware which are used to implement ERP allow the late followers such as firms in Pakistan to implement ERP much cheaper as compared to early adopters in developed world for example. Third the experience got by ERP vendors and consultants from early ERP implementation and or dealing with ERP implementation difficulties/failures can be used while implementing ERP in late followers. This means that implementing ERP in Pakistan can be beneficial for the firms however other facts can also be considered to analyze the ERP implementation in Pakistan from a different perspective.

1.7.2. Culture and other non-economic issues

Culture can be defined as set of norms, beliefs, values, routines, habits, religion, attitude etc. that is shared by a group of people living in particular place. The cultural effect of ERP implementation can be analyzed from two different perspectives. On the one side, the cultural misfit is possibly to occur when an information system is developed in one culture such as in developed countries and

implemented in other culture such as developing countries, Pakistan for example. Thus implementing ERP in a developing country such as in Pakistan can face more resistance from employees of adopting firms (Shaukat, 2009). According to other perspective, ERP embedded cultural effect can help the adopting firms, in developing countries, to transform their organizational culture for achieving the full benefit from ERP implementation. Rajapakse (2012) investigated "Can ERP adoptions change organizational culture in developing countries in Asia? An empirical investigation" and found that cultural of case firm as ERP adopter, in Sri Lanka, has been slowly transforming to ERP embedded western culture after over 10 years of going live. Culture misfit can be the challenge/ barrier, for the ERP adopters in during and in early post implementation years, however, the ERP adopting companies can manage to alter organizational culture to ERP embedded western culture in the long run.

The religious collectivism (Islamic value system), Britain Bureaucratic working system such as tall organizational structure and centralized decision making in firms, American result oriented and accountability management practices are the key determinants of culture in Pakistan (Ahmad, 1996). According to the individualism/collectivism value in "index of the cultural dimensions by (Hofstede, 2001)" Pakistan has least score with 14 as compared to 91 and 67 for US and Germany respectively which actually represent the western culture where ERP developed. Pakistan is the country which got independence on the basis of religion. Majority of population (around 95 percent) in the Pakistan are Muslims thus religious teaching has immense impact on the culture. Islamic value system of collectivism can be the main cultural barrier that employees in firms may severely resist ERP implementation. Collectivism in the culture may affect the ERP implementation in two ways. Employees may be afraid of individualism offered by ERP as against existing collectivism in organization culture. And potential right sizing in the adopting firms in post ERP implementation period may lead to strong reaction by labor unions because of persistence of collectivism in the culture— in contrast of individualism, the system in which not only to take care your immediate family members but also others (Rajapakse & Seddon, 2005).

Hofstede (2001) identified the high difference of power distance dimension between developed and developing countries. The developed countries have significantly lower power distance score than that

of developing countries (Hofstede, 2001). Centralized and Decentralized decision making style in developing and developed countries respectively can be one the explanations that lead to such power distance difference between developing and developed countries (Rajapakse & Seddon, 2005). ERP developed in the countries where the decentralized decision making is the organizational culture, so preaching the same culture in the developing countries such as in Pakistan—a country where all the decision are made in head office of a particular firms and imposed on the employees throughout the country (Hussain & Hussain, 1993) — can be problematic when the new technology such as ERP is deployed.

Availability of manpower cannot be the issue in Pakistan however, some time it becomes difficult for the firms to hire talented people in the firm because of government invention (Khilji, 2001). The main cause behind IT and non-IT projects' failure in Pakistan is lack of expertise in manpower (Shaukat, 2009). The reason behind that can also be the fact that the majority of population in many developing countries is illiterate hence companies many not be able to hunt desired talent. Therefore usability and performance impact of ERP can suffer from language problems such as lack of required proficiency in understanding the English language in Pakistan in order to use the ERP effectively.

1.8. Other factors

The problems related to IT adoption are well identified in literature. By conducting a survey, (Shaukat2009) tested eight possible problems that companies usually face while adopting a new technology. These problems are deficiency of trained manpower, insufficient telecommunication infrastructure in Pakistan, improper IT planning, Proper IT system selection, apposite use of computer, Management inadequate knowledge of IT system, severe employees' resistance, and Management avoidance to investment and confirmed presence of these problems in adoption of IT in Pakistan. The following steps have been taken by Government of Pakistan in order to reduce/eliminate these identified problems.

Strong IT infrastructure is the key for the development of firms and the country (William & Sawyar, 2005) which is also true for the Pakistan. Unlike developed countries, Pakistan's IT infrastructure is

insufficiently established in order to be self-sufficient (Shaukat, 2009). Pakistan has been striving to have well recognized IT infrastructure for achieving desired development (Kazmi, 2000). The government of Pakistan has been investing millions of dollars on developing IT infrastructure and human resources development. There are three major areas that constitute the IT infrastructure of any country: hardware and software, human resources and telecommunication. In absence of computer hardware manufacturing in Pakistan, Government has reduced the levies and duties on import of IT hardware (Shaukat, 2009). The computer hardware is cheap to import in Pakistan therefore hardware production is infeasible there (Khan, 2004) thus computer vendors in Pakistan are indeed assemblers.

To motivate the software development in Pakistan, Government is offering lot of incentives to software houses for starting software trading however these software houses produce application software and system software is being imported from developed countries. The telecommunication sector is one of fastest growing sectors in Pakistan. The number of cellular phone users in Pakistan was 30 million in 2006, and according to Pakistan Telecommunication Authority this user's number has crossed 139 million at the end of May 2014. The Number of 3G/4G users has become doubled from 14.6 million to 31.7 million from July, 2015 to July-2016 respectively. These recent development in IT infrastructure in Pakistan can help firms to implement ERP, import of hardware for implementing ERP can reasonably be cheap and availability of trainers can make it easy for firms to train their employees.

1.9. Economic condition

Economic conditions prevails in a country can be a possible motivation behind the ERP implementation by the firms. (Kim, Kang, Lawrence, & Tom, 2008) investigated the impact of IT investment on GDP growth and found significant positive effect of IT's software and hardware on GDP growth of Republic of Korea. Unlike (Kim et al., 2008) we analyze GDP, average aggregate ROA of firms[1] and ERP implementation trends for determining the possible purpose behind the ERP implementation by adopters in order to estimate that what may be expected by the firms in Pakistan while deciding ERP

[1] Average aggregate ROA of firms is the average ROA of all the firms reported in four different versions of State Bank of Pakistan's Balance sheet analysis of joint stock companies registered on Karachi stock exchange documents used for collecting the financial data for this study.

implementation. This exercise can somehow help to analyze whether ERP implementation leads to better GDP or better (worse) GDP leads to ERP implementation?

Table 1.1
GDP and ROA trend analysis

The purpose of this table is to critically analyze the ROA trend especially during the years in which the majority of ERP implementation took place. Column 1 shows years from 2004 to 2013 whereas column 2, 3 and 4 indicating the percentage of total ERP adopters implemented ERP within a particular year, GDP and ROA respectively. The ROA*, in this table, is the average ROA of all the firms reported in the different version of reports published by State Bank of Pakistan such as Balance Sheet Analysis of Joint Stock Companies registered on Karachi Stock Exchange. The entire value in columns 2 to 4 are in percentage.

Year	ERP adopters	GDP	ROA*
2004	0	7.37	12.4
2005	6.49	7.67	13.2
2006	10.39	6.18	12.5
2007	11.69	4.83	9.7
2008	9.09	1.70	7.2
2009	14.29	2.83	6.3
2010	15.58	1.61	8.3
2011	12.99	2.75	8.58
2012	9.09	3.51	7.46
2013	3.9	4.41	9.78

A close analysis of table 1.1 and figure1.1 can help in estimating the possible motivation behind ERP implementation in Pakistan. A decline in GDP and average ROA of overall firms registered on Karachi Stock Exchange and increasing percentage of adopters can be treated as primary motivation behind the ERP implementation. It can easily be observed that as the GDP is declining the percentage of ERP adoption is increasing such as in 2004 and 2005 the GDP is 7.4 and 7.8 in the table 1.1 respectively and corresponding ERP adoption is zero and 6.5 percent. A significant decline in GDP from 2006 to 2011covers the period in which the majority of sample ERP implementation has been taken place. The highest percentage of sample ERP adopters—15.6 percent, implemented ERP in 2010 and this is the year in which lowest GDP was realized. Such an ERP adoption and GDP trends indicate that the GDP decline can be the main cause of ERP implementation in Pakistan therefore the purposed behind the ERP implementation can be to sustain the existing competitive position. This means the non-adopters are expected to face a decline in performance in post ERP implementation period as compared to their ERP adopting counterparts. This point can be the starting point for synthesizing the cost of not investing in ERP that we discuss in detail in next chapter.

We claim, to the best of our knowledge, that this is the only study conducted ever on the impact of ERP implementation on the financial performance of adopting and non-adopting Pakistani non-financial firms. Admittedly, ERP adoption in Pakistan is low. However, recently, more and more firms have started to implement ERP and this is one of the motivating.

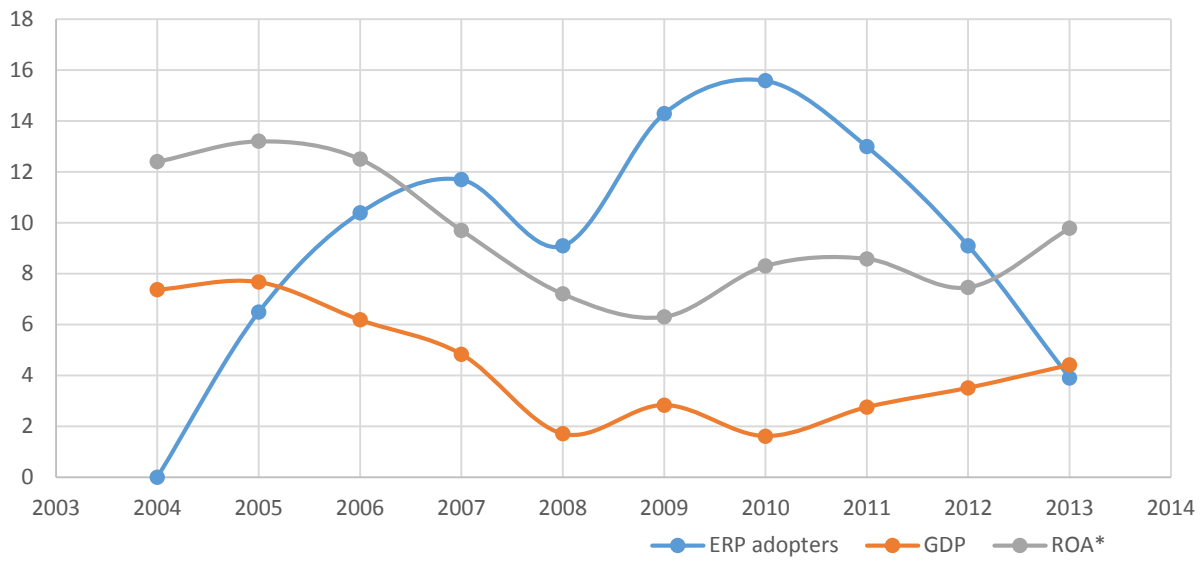


Figure 1.1: ERP adoption, GDP and ROA trend

Only one study we could find in Pakistan which has investigated the impact of ICT on financial performance of the firm by (Shaukat, 2009). The majority of papers on ERPs in Pakistan are on critical success factors (which we discussed in detail in literature review of this study). The main reason of dearth of research on such an interesting topic in Pakistan is unavailability/difficulty in collecting required ERP data to explore. The similar problem with regard to data collection may be faced by researchers in other parts of the world in general and developing world in particular.

There are many differences between this study and that of conducted by (Shaukat, 2009). First, Shaukat (2009) studied the impact of ICT investment on profitability through management efficiency in general whereas this study is on impact of a particular IS such as ERP, on firm performance. Second, Shaukat (2009) could include 48 firms that invested in ICT from banking and manufacturing sector however sample in this study is a way larger and unique which consists on 86 ERP adopters from non-financial sectors only. Third, contrary to (Shaukat, 2009) the banking sector is not the focus of this study due to

unavailability of both financial and ERP implementation data. Fourth, this study is comparing the performance of ERP adopters with those of non-adopters which is minimum requirement to control for industrial, firm and economy impact on performance through setting a benchmark (Hendricks, Singhal, & Stratman, 2007) whereas (Shaukat, 2009) has not included the non-adopters instead he could manage to collect the ICT expense data through different sources and just consider the post ICT investment performance from 1994-2004. Finally, as compared to (Shaukat, 2009), our study considers the pre-through and post ERP implementation performance of adopters and non-adopters in the period from 2000 to 2013 as per procedure mentioned in later sections.

1.10. Research questions

The main research question in this study is

- Does ERPs implementation affect the financial performance of adopters and non-adopters in Pakistan?

In this study we empirically investigate the impact of ERP implementation on financial performance of adopters and non-adopters in Pakistan. We are also interested to do in depth analysis to know if ERP implementation generates operational and or strategic benefit for adopters as compared to that of non-adopters. Furthermore we also propose to consider the cost of not-investing in IT in general and in ERP in particular and develop a framework to evaluate the ERPs effect on Economic Value Added (EVA) of the adopters. All above helped us to formulate the following sub-questions.

- Does post ERP implementation performance improve as compared to pre ERP implementation performance of adopters only?
- Is there any difference between pre-to-post ERP implementation financial performance of adopters and non-adopters?
- Is there any cost of not investing in ERP?
- Does ERP implementation create operational benefit for adopters as compared to non-adopters?
- Does ERPs implementation offer strategic benefit to adopters as compared to non-adopters?

As depicted by figure 1.2, a literature review is given in chapter 2. We develop a conceptual framework for evaluation and justification of information technology investment in chapter 3. Next the hypotheses development, variable selection and variables definition are specified in chapter 4 which is followed by chapter 5 in which data and methodology are discussed. Chapters 6, 7 and 8 contain results, discussion and limitations and conclusion and future research respectively.

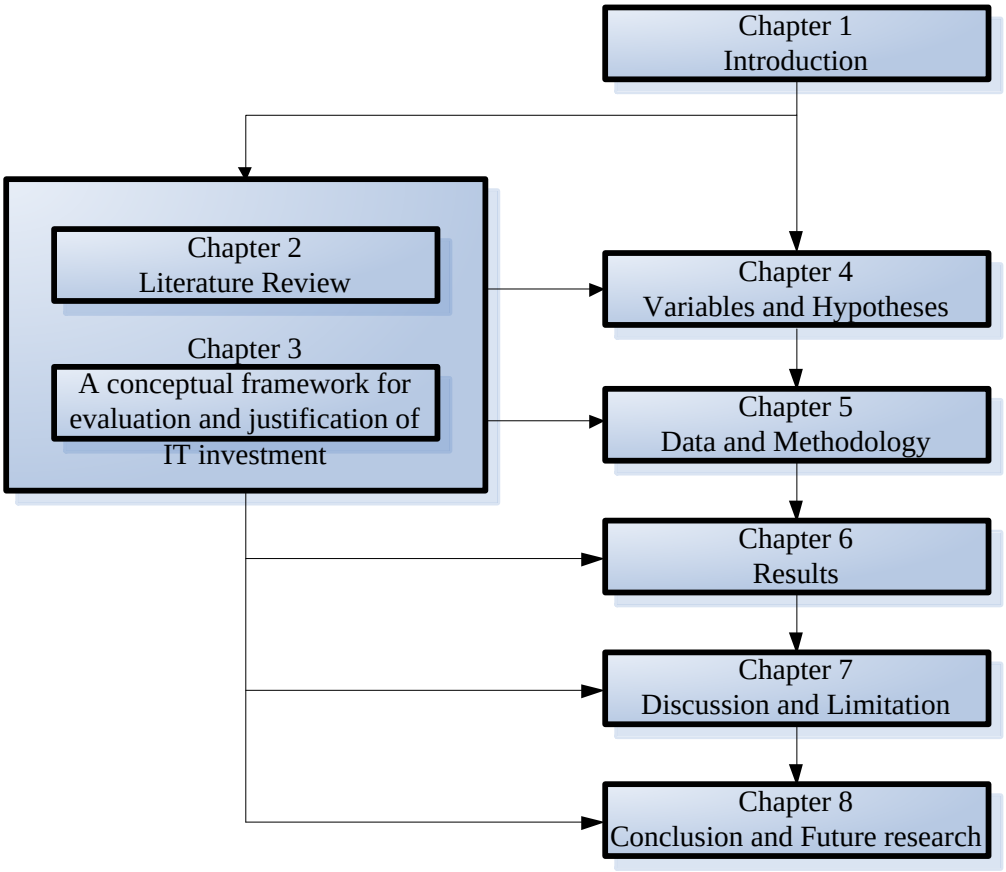


Figure 1.2: Thesis structure

Chapter 2

Literature review

2.1. Objective of the chapter

In this chapter the literature on the business value of ERP implementation is discussed. We briefly elaborate the different dimensions in which the research on business value of ERP has been conducted. We first discuss the empirical evidence on performance impact of ERP in developed countries and then explain what methodology has been used in producing results. Special emphasis has been given to include the results of those empirical studies on the topic that have compared the performance of ERP adopters with that of non-adopters. To analyze whether the results found in developing countries are similar to that of reported in the developed world we discuss the results of developing countries. Final a brief discussion is given on which perspective ERP research has got attention in Pakistan.

2.2. Business value of ERP investment

Unsatisfactory empirical results of ex post performance effect of IS investment threw a heavy stone in the center of static water in a pond which triggered the waves of research surrounding its unexpected opposite consequences. A huge research work followed in a vibrant way in order to find out possible reasons behind no or negative impact. Researchers paid lot of efforts in order to probe the economic value of information system (IS) from different perspectives at various levels and in a different periods of time. The purpose of all of these studies was to determine the economic value of an IS investment. The studies on business value of IS can be classified on the basis of their basic perspective from diverse perspectives such as “What do we know about? What do we still need to know?” in order to identify the gap and “how do we fill the identified gap?” This classification has been done by (Kohli & Grover, 2008) and (Schryen, 2013). Schryen (2013) also used an alternative classification which strictly related to notion, level, object and time of analyzing IS business value.

2.3. Conceptual classification of research work on IS business value

The stream of research that has studied the business consequence of IS investment used different notions such as “ worth”, “benefit”, “value”, “outcome”, “organizational performance”, “economic impact”

etc.(Bharadwaj, 2000; Brynjolfsson & Hitt, 1996; Kohli & Grover, 2008; Melville, Kraemer, & Gurbaxani, 2004). All these inconsistent notions of IS business value not only show the lack of its widely accepted definition (Oz, 2005) but also difference in researchers' understandings. A large subset of empirical research on business value investigate the association between productivity and IS investment(Brynjolfsson & Hitt, 1996), Return on assets, return on sales (de Andres, Lorca, & Labra, 2012; Hunton et al., 2003) , Tobin's Q (Brynjolfsson & Yang, 1997) etc. whereas other studies emphasize non-financial effect of IS investment such as role of IS as enabler which enables the organizational capabilities (Kohli & Grover, 2008) and strategic position (Irani, 2002) that can bring the benefits. A more complex situation arises when the results such as improved ROA, productivity gains etc. are interpreted. Some evaluators only take into account the internal gain of IS investment (Poston & Grabski, 2001) whereas other evaluators may consider the gain as compared to competitors (de Andres, Lorca, & Labra, 2012).

While reviewing the IS business value literature, Schryen (2013) concludes that a large number of early studies such as conducted in late 80s and early 90s on IS business value led to the notion of productivity paradox which means IS implementation has no or negative effect on productivity and economic growth. The more recent studies, conducted particularly from 1995 to 2007, report a much positive picture of IS impact on productivity however still a good number of studies provided either no or negative impact of IS investment. Dedrick et al. (2003) and Devaraj and Kohli (2000) in their review papers report overall positive productivity impact of IS investment.

2.4. Level of IS business value examination

Level can be defined as the extent to which business value of IS investment is investigated. Literature furnishes different levels such as individual, firm, industry and economy levels at which the performance impact of IS investment has been examined (Brynjolfsson & Yang, 1996; Chau, Kuan, & Liang, 2007; Devaraj & Kohli, 2000). (Melville et al., 2004) reviewed the literate and strictly developed a model that includes all these level. Brynjolfsson (1993) argues that taking any of these levels by any study can contribute in explaining the productivity paradox. Schryen (2013) took into account the level

of examination while reviewing the IS business value for synthesis of research findings at different levels.

Dedrick et al. (2003) and (Wan , Fang, & Wade, 2007) claim that PP has been resolved at firm level because of good response by researchers and managers toward the four possible problems—mismeasurement, mismanagement, time lag and redistribution of profit, cited by Brynjolfsson (1993). Dedrick et al. (2003) also conclude after an extensive review of literature that IS investment contributes positively in the national productivity and economic growth, but only in developed countries where as the literature review papers on business value of IS investment are silent about productivity effect of IS investment in developing countries. Schryen (2013), in his extensive literature review paper, could find only a single study i.e. (Lin & Chiang, 2011) that reports the presence of PP in both developed and developing countries.

The literature reports mixed results about the effect of IS investment on productivity at industry level. Dedrick et al. (2003) find positive labor productivity whereas Devaraj and Kohli (2000) conclude miscellaneous effects in the literature. Han, Chang, and Hahn (2011) investigate the impact of inter-industry proliferation of IT on total factor productivity growth and find significant positive impact of IT investment made of supplier industries on the productivity of downstream industries. They used the data of US manufacturing industries and conclude that the intensity of positive effect of IT spillover is greater in the long run than the short run because of the time period required for learning to reap the greater benefits from IT spillover.

2.5. Time of analysis

Schryen (2013) stresses that the stream of research on IS investment can be classified from the perspective of analysis focus on ex ante and or ex post IS investment. Ex-ante analysis of IS investment just helps the firms to select the best from IS investment alternatives in order to achieve organizational goals. Whereas the purpose of ex-post analysis is to test the extent in which the IS implementing firm has been successful the realizing the expected benefits. Even the study by Anderson, Banker, Menon, and Romero (2011) investigates the impact of IS implementation duration on post implementation performance. We mainly focus on ex post performance impact of ERP in an effort to identify the useful

inputs for ex ante analysis. We will discuss this in detail in next chapters. (Ajit et al., 2014; Aral & Weill, 2007; Badescu & Garcés-Ayerbe, 2009; Hendricks et al., 2007; Hitt, Wu, & Zhou, 2002; Kallunki, Laitinen, & Silvola, 2011; Poston & Grabski, 2001; Shaukat, 2009) are the studies that focus on post IS implementation performance whereas the other stream of studies addresses the issues related to ex ante analysis in order to select the most suitable option for IS investment. The studies that mainly focused on ex ante analysis are (Ahituv, Neumann, & Zviran, 2002; Aloini, Dulmin, & Mininno, 2012; Amid et al., 2012; Angelou & Economides, 2009; Arnold, 2000; Asosheh, Nalchigar, & Jamporazmey, 2010; Bacon, 1992; Joan Ballantine, 1995; J. Ballantine & Stray, 1998; Busby & Pitts, 1997) etc. among others.

2.6. Object of IS value analysis

The object of evaluation varies significantly among IS business value researchers, while investigating the performance impact of IS investment. Some studies strictly take into account the overall IS, whereas other consider specific IS asset such as personnel and training, IT capital etc. (Brynjolfsson & Hitt, 1995). One stream of research has also tested the effect of particular modules and the effect differential between adopters of complete suite of particular IS and adopters of a few modules of a particular IS such as ERP (Etezady, 2008). (Anderson et al., 2011) investigated the impact of ERP implementation speed on the financial performance of the firm and found statistically significant and better financial performance in operational efficiency and strategic edge.

2.7. Performance variables

One of the most important questions related to economic justification of IS investment is: what actually represents the effect? The body of literature of appraisal of IS projects has enormously increased during last two decades and so is the case with variables to measure the effect. The productivity has well been addressed by (Brynjolfsson, 1996). Other researchers have addressed product quality and capacity utilization (Barua, Kriebel, & Mukhopadhyay, 1995), productive and production efficiency (Chen & Lin, 2009), customer satisfaction (Devaraj & Kohli, 2000).

Substantial investments in ERPs by firms are expected to bring tremendous improvement in processes by applying the industry's best practices. Dos Santos, Peffers, and Mauer (1993) argue that the investment in non-innovative technologies that maintain the status quo in firm processes are not likely to increase market value and profitability of adopters whereas chances of improvement in performance indicators are extremely bright for firms that implement innovative technologies such as ERPs (Hunton et al., 2003). However, Poston and Grabski (2001) and Hunton et al. (2003) reported no improvement in financial performance after the adoption of such innovative technological investment as ERP. Hunton et al. (2003) argue that even though their results are consistent to that of (Poston & Grabski, 2001) in terms of no improvement in financial performance of adopters, they found a significant decrement in the financial performance of non-adopters. The benefit of ERPs implementation to adopters, in their case, can be interpreted as protection from decrement in financial performance. While investigating the financial performance of the biggest Spanish ERP adopting firms as compared to that of non-adopters de Andrés, Lorca, and Labra (2012) found hundred percent contrary results to that of (Hunton et al., 2003). They found a significant decrement in profitability of the biggest Spanish ERPs adopters as compared to the unchanged profitability of non-adopters in post-implementation period. These studies indicated the significance of including the financial performance of non-adopters while studying the impact of ERPs on the profitability of adopters in order to detect ERPs' true effect. Following these studies, we also considered the ex-ante and ex-post performance of adopters and non-adopters to see any effect of ERPs on financial performance of adopters and non-adopters.

2.8. ERPs in developed world

The majority of studies that examined the effect of ERP system implementation on firm performance have been conducted in the developed world and found mixed results. Poston and Grabski (2001) examined the ex-ante and ex-post impact of ERP on firm performance of adopters. Kallunki et al. (2011) examine and find the significant positive impact of ERPs implementation on subsequent Finnish firm performance through formal management control. Tian and Xu (2015a) investigated a performance volatility effect of ERPs on 981 fortune 1000 firms and found that ERPs mitigate the performance risk. While comparing the adopting and non-adopting pairs' ex-ante and ex-post ERP impact on performance

over three years (Hunton et al., 2003) found significantly better results in terms of ROA, ROI and Asset Turnover for adopters as compared to that of non-adopters. They couldn't find any improvement in ROA, ROI and Asset Turnover for adopters however financial performance for non-adopters decline significantly in post ERPs implementation period. This is what we call in this study the cost of not investing which has not been considered while evaluating the ERPs project in the ERP literature.

Hitt et al. (2002) examined the business impact and productivity of ERP investment using large firms (Fortune 1000) from 1986 to 1998 time period by comparing adopters and non-adopters and found that financial markets (as measured by Tobin's q) are rewarding adopters during ERPs implementation despite a slowdown in productivity and business performance shortly after ERPs implementation. They couldn't estimate the long-term effect of SAP's ERP implementation on firm performance. They included the remaining publicly traded firms (control group) without matching their sample adopters' performance with that of non-adopters prior to ERPs implementation. However, in order to generate the powerful test statistics, accounting-based metrics must be matched on the basis of prior performance (Barber & Lyon, 1996). Matching on prior performance provides the ground for adjusting for mean reversion in accounting metrics which reflect no effect of the event under consideration thus it provides a good starting point to conclude the effect in post-implementation period. Without matching control group on prior performance, the result may be confusing to conclude if the observed effect is an event under consideration or due to mean reversion.

Based on data collected from 50 publicly traded firms which announced ERPs adoption in between1993 and 1997, Poston and Grabski (2001) assessed the pre-to-post effect of ERPs on firm performance using paired *t*-test and found no effect on ERP adopters' performance. The authors reported a reduction in the cost of goods sold until three years after ERPs implementation. Their result is questionable because of their methodology. The major drawback of their results was that they didn't control for prior performance effect, industry or economy effect by matching non-adopting firm for each ERPs adopter in the sample of their study. Therefore, it may not be correct to associate the impact on profitability found by Poston and Grabski (2001) to ERPs implementation. Hendricks et al. (2007) argue that while

estimating performance effect of the corporate decision, it is a minimum requirement to control for normal changes in performance through the benchmark.

Hendricks et al. (2007) analyzed the objective data of US firms for 186 announcements of ERP implementation, 140 supply chain Management, 80 CRM implementation and their matching non-adopting competitors to determine their impact on financial performance of adopters and non-adopters. They found mixed results for the financial benefit of this implementation. In the case of ERPs, they found a significant positive impact on profitability but not in stock return. They reported greater improvement in profitability for leaders than followers. The SCM adopters enjoyed both improved profitability and stock return whereas firms that implemented CRM couldn't experience any improvement in either profitability or stock return. The authors argue that although their results are not uniformly positive for different enterprise systems, they claim that their results are still motivating because they didn't evidence any negative performance associated with any of these ES.

2.9. ERPs and evidence from developing countries

Handoko, Aryanto, and So (2015) investigated the impact of ERPs and supply chain management on Indonesian firm performance through competitive advantage. Using the data of 148 Indonesian firms, they found a significant positive impact of ERPs on the firm performance. The authors also evidenced the positive impact of supply chain management on the competitive advantage of the firm. ChangwooPhilipLim and Yiseokhui (2007) analyzed the impact of ERPs on corporate performance by using 346 observations which were obtained from 160 Korean adopters and non-adopters and reported better financial performance such as profitability, account receivable, and turnover ratio for Korean adopters. The authors confirm the greater income per employee and lesser administrative expenses as compared to those of non-adopters.

Based on 50 Chinese chemical firms which implemented ERPs from 1998 to 2005, Liu, Miao, and Li (2008) investigated the impact of ERPs on pre-to-post financial performance of adopters as compared to that of non-adopters and found no significant impact of ERPs on financial performance during two-year implementation period and one, two and three years after implementation. The authors reported a decline in financial performance in one and two years after ERPs implementation and a little

improvement in financial performance was observed in the third year of ERPs implementation. The authors concluded that the ERPs may take a longer period of time to realize financial benefit. Contrary to the authors' view, as argued in coming sections in this study, as the number of ERPs implementation increases within the same industry, the chances of getting and retaining competitive advantage is decreasing. Assume there were only the 50 firms in the chemical sector and all of them for example, implement the ERPs what will be the effect on the financial performance of the firms?

Kim and Roh (2009) conducted research to investigate the effect of ERPs on the financial performance of Korean firm. Their sample consisted 89 adopters and 89 non-adopters. The financial ratios were used to measure the impact of ERPs on the performance of firms with and without ERPs. Authors used match pair methodology to control for size, industry and economy effect. The results of t-test revealed no difference in financial performance of adopters and non-adopters.

Parto, Sofian, and Saat (2016) investigated the impact of ERPs on the financial performance of Iranian manufacturing firms. The authors analyzed the field data using the multivariate statistical method (partial least square) found that each module of ERPs has a separate impact on financial performance of the firm. Almost all of above mentioned empirical studies conducted in developing countries indicates positive or no impact of ERPs.

2.10. Research on ERPs in Pakistan

Following the maturity of ERPs implementation in the developed world, the Pakistani firms have started to invest in ERP since 2002. Various studies have been conducted to report a different issue related to information technology in general and ERPs in particular. Nizamani, Khoumbati, Ismaili, and Niazamani (2014) noted the dearth of studies to propose the clear guidelines to implement ERPs in higher education institutions in Pakistan. They proposed a conceptual framework comprising six dimensions based on in-depth review of the literature, proposed a model in prior studies and survey in which the questionnaire was developed and sent to ten reputable higher education commission's recognized higher education institutions which have already implemented ERPs (named as Campus Management Solutions).

By employing an exploratory case study method Ijaz, Malik, Lodhi, Habiba, and Irfan (2014) explore the critical success factors in pre, through and post implementation phases. In-depth face to face interviews have been conducted with fifteen respondents which include nine end users at a government-owned electric supply corporation of Pakistan and 6 consultants. The data was probed through NVivo 10 software and found six, twelve and six critical success factors for pre, through and post-implementation stages respectively.

While examining the critical success factors affecting ERPs implementation in Pakistan, Khattak and Khattak (2012) analyzed the data which was collected through a survey from four Pakistani firms and found eleven critical, six least critical and three not critical factors for successful implementation of ERPs in Pakistan. The insights provided by them, they claim, will eradicate the chance of ERPs implementation failure in Pakistan. Based on a case study of a government-owned firm, Shah, Khan, Bukhari, and Raza (2011) explore the impediments of successful ERPs implementation and reported the low involvement of end user, lack of communication between the end user and developers and lack of top managerial support as critical failure factors of ERPs implementation.

A survey-based exploratory study allowed Shahzadi, Shoaib, and Lodhi (2014) to examine the impact of ERPs on various human resource management practices. They sent the questionnaire to the ERPs end users in five Pakistani firms which belong to different sectors in Pakistan. The findings of regression analysis in that study reveal a negative relationship between ERPs implementation and recruitment and selection along with no relation to benefits and compensation and positive relation with training and development of sample firms' employees which in turn positively related with organizational productivity. Another study by Lodhi, Mehmood, and Bilal (2012) proposed a model that captures the impact of ERPs on the performance of different activities and their impact on financial performance of the firms through literature review and models proposed in prior studies. Shah, Bukhari, Hassan, Shah, and Shah (2011) conducted a survey-based study to identify the socio-technical factors affecting successful ERPs implementation in Pakistan. They sent questionnaires to managers for collecting data. Analysis of data revealed seven critical success factors need to be consider while implementing ERP in Pakistan.

The purpose of presenting the literature from Pakistan is to ensure that none of the studies have ever empirically tested the impact of ERP implementation on the financial performance of the adopters and non-adopters as we are attempting to investigate the issue in this study.

Chapter 3

A conceptual framework for evaluation and justification of information technology investment

3.1. Objective of the chapter

The objective of this chapter is to identify a frame for analyzing and justifying an IT investment. IT investment represents a huge capital investment by any firms. No return or negative return on such an important investment has made it difficult for the managers to jusify their IT investment decision projects. Lot of research has been done to identify the causes behind generating contrary results in term of financial return. Furthermore, recent reported IT investment projects failures have made many firms bankrupt or the losses of those IT project failures have been huge. Therefore, there is an immense need of a framework that may help managers to justify their IT investment decision.

3.2. Introduction

Evaluating Information Technology (IT) projects appropriately has become a vital issue for companies since IT is a major investment for most (Chou, Chou, & Tzeng, 2006; Kumar, 2002; Wu & Ong, 2008). Therefore evaluating and selecting the most appropriate one from the set of available IT projects is very important and challenging task (Lee & Kim, 2001; Shehabuddeen, Probert, & Phaal, 2006). IT is characterized by a high level of uncertainty, difficulty in estimating and measuring the costs and benefits (tangible and intangible), rapid development and short life of IT hardware (Angelou & Economides, 2009). Firms are eager to learn how to effectively and efficiently use their scarce resources for developing and sustaining competitive advantage. Selecting a suitable IT project from the outset can help firms to achieve and/or sustain competitive advantage, but if not managed properly it can disastrously harm a firm's competitive position (Bowen, Cheung, & Rohde, 2007). Even firms with good management capabilities cannot expect good results if a poor IT project is selected; the selection of an appropriate project from outset leads a firm toward its goal and a wrong selection of IT project can never direct a firm to expected results. Researchers don't have consensus yet on risk and return relationship however many recent studies on risk and return relationship such as (Chiang, Li, & Zheng, 2015; Demirer, Jategaonkar, & Khalifa, 2015; Frazier & Liu, 2016; Salvador, Floros, & Arago, 2014)

reported significant positive relationships between them. According to the positive risk and return relationship reported above by recent studies, risky investments, such as in IT assets, should offer a higher return than less risky investment. Contrary to this, Dewan and Ren (2011) found no significant relationship between IT investment and return. However, they found a significant positive relationship between IT investment and firm's risk level. The literature contains many examples of unsuccessful IT investments such as mentioned in Table 3.1. Griffith, Zammuto, and Aiman-Smith (1999) found the failure rate of large IT investments as high as 75%. A more recent survey by the Standish Group in 2009 reveals that over 65% of the sample IT projects fails in terms of three conventional measures (time, budget and benefits) (Masli, Richardson, Sanchez, & Smith, 2011). Is the IT investment really valuable to firm? (Kohli & Grover, 2008) answer this question as "Its innate logic implies to us that if IT is not valuable, then we are engaging in research on something that is not valuable and hence we are not valuable!" Despite the high failure rate of IT investments, the number of IT adopting firms has been increasing every year. Does this mean that firms tend to lose their value while making an IT investment decision? Absolutely not, but it can be the Cost of Not Investing in IT (CNIIT) may leave no other option to the firms than to invest. Many IT investment valuation techniques have been recommended but CNIIT has hardly been used by any project evaluation technique. The objective of this chapter is to develop a conceptual framework and demonstrate its integration with NPV (one of the most used techniques to analyze potential projects in the real world). This is to help managers not only to to select an appropriate project from the outset but also justify their investment decision.

3.3. Literature Review

Evaluation and selection of an IT project have, for numerous reasons, been reported as a very difficult and challenging task. Angelou and Economides (2009) argue that the rapidly changing environment and high level of uncertainty associated with IT investments make it problematic for managers to evaluate and justify an IT investment (Powell, 1992). The uncertainties tied with IT investment include specification vagueness, unrealistic budget, impractical time schedules, real-time performance loss, poorly communicated IT project specification, the rapidly changing price etc. (Kumar, 2002). Gunasekaran et al. (2006) recognize that most firms tend to focus more on benefits than total costs,

therefore failing to consider the total relevant costs of IT. Furthermore, firms need to take into account both short and long-term costs and benefits in order to justify their IT investment (Gunasekaran et al., 2006). Many studies have been conducted to answer the question of how to evaluate IT projects. The answers so far are not fully satisfactory. Some researchers associate this with the complexity of the problem while other relate it to the insufficiency of the traditional techniques to consider qualitative and quantitative aspects of IT (Milis & Mercken, 2004). Therefore, several models have been proposed that are unpopular among practitioners who actually make IT investment decision.

IT/IS investment has been evaluated from different perspectives. While reviewing the literature on IT and firm performance, (Melville et al., 2004) argue that literature on relationship between IT and performance is indecisive and divergent in how the studies are hypothesizing the key measures and relationship among them. Therefore different models have been proposed for evaluation of IT performance impact. (Melville et al., 2004) proposed a model that integrates all the models they could find in their literature review. According to their model, the extent to which IT/IS adopting firm can take benefits is determined by internal such as firm specific resources and external factors such as trading partners, competitors and economic environment.

Recently, another review study on IS business value has been conducted by (Schryen, 2013). (Schryen, 2013) reviewed more than 200 papers on business value of IS for addressing issues related to IS e.g. synthesizing existing knowledge on IS, identification of gaps and proposing the ways to fulfill those gaps. According to the model proposed by (Schryen, 2013) through integrating the different models in literature, there are different factors that determine the IS business value in term of improve firm, market and accounting performances. The factors include the IS and non-IS investments, firm specific, industry, country and lag effects. (Schryen, 2013) further argues that results on the relationship between IS and performance are varying widely from one study to another and that a lag effect may be mainly responsible for mismeasurement of IS impact on performance. Although mismeasurement has been held responsible as potential cause of not determining any effect of IS on firm performance, least effort has been given to empirically test if the mismeasurement is real culprit of hiding the IS effect on firm performance. The understanding about mismeasurement in IT/IS can range from miscalculation of

performance variables to something that is still lacking. In order to address this least focused issue of mismeasurement in term of something that is still lacking, we synthesize what is already known to identify the unknown and determine the way to use the concept we develop in later parts of this chapter in order to determine the true IS business value.

3.3.1. Net Present Value (NPV) and IT investment

Net Present Value is regarded the superior traditional capital investment appraisal technique by academics (Shinoda, 2010). As a result the researchers who develop and recommend new IT project evaluation techniques, have mainly criticized the NPV (Angelou & Economides, 2009; A. Dixit, 1995; Huisman & Kort, 2002; MacDougall & Pike, 2003; Olafsson, 2003; Smit & Trigeorgis, 2007; Wu, Li, Ong, & Pan, 2012; Wu & Ong, 2008). Researchers have well documented many serious shortcomings of traditional capital investment appraisal techniques (CIATs) such as NPV when evaluating an investment. Firstly, NPV assumes that investments are reversible but in real world the investments in IT are irreversible (Angelou & Economides, 2009; A. Dixit, 1995; Huisman & Kort, 2002; MacDougall & Pike, 2003; Olafsson, 2003; Smit & Trigeorgis, 2007; Wu et al., 2012; Wu & Ong, 2008). Secondly, NPV tends to not consider the potential value of managerial flexibility for very important and risky IT investments. Managers may defer/expand the investment in IT at a certain stage if the conditions are unfavorable/favorable (Angelou & Economides, 2009; Wu et al., 2012; Wu & Ong, 2008) it means NPV tend to undervalue the IT investment (Kumar, 2002). Thirdly, NPV ignores the strategic value—actions of competitors that may affect the estimated cash flows, rooted into IT investment (MacDougall & Pike, 2003; Smit & Trigeorgis, 2007). Finally, it does not take into account future uncertainties associated with IT investment (Linton, Walsh, & Morabito, 2002; Shehabuddeen et al., 2006) hence is by no means sufficient for evaluating the IT investment (Angelou & Economides, 2009).

Of course, the NPV, or any of the other criterions, has never and will never be the only variable to decide on an investment. They are merely pieces of information that the decision maker can use. It is important to note that all these criteria require the same information on cost and benefits, but only use different hurdles to see if the project is profitable. With benefits intangible and, more importantly, deemed not measurable, other concepts have been developed, such as Total Cost Ownership (TCO),

which avoid the non-measurable benefits. Non-measurable cost and benefits doesn't confirm their non-existence.

Besides all above mentioned limitations of NPV, NPV provides criteria and according to that one will accept a project if the present value of expected cash flows is at least as large as its costs and reject otherwise. This criterion of NPV does not consider the cost of not investing in a project such as IT. To address this we propose a model called IT Investment Valuation and Justification Model (ITIVJM) that addresses the problems associated with IT investment such as Productivity Paradox (PP), IT investment justification problem, etc. ITIVJM can easily be integrated with any CIAT (Machen, Dickinson, Williams, Widiatmoko, & Kendall) such as NPV and recently proposed techniques such as RO.

3.3.2. IT investment failure and Productivity Paradox (PP)

The literature of IT investment has frequently reported IT investment failures in terms of not meeting the original expectation about cost, time, or benefit. As table 3.1 shows the recent IT/IS investment failures such as ERP failures in different firms. Many researchers presented facts and figures about IT investment failure based on results of surveys conducted by organizations such as Standish group, KPMG, IBM, Gartner, etc. A KPMG international survey across the 22 countries reveals that 86 percent of the respondents reported a loss of not achieving up to one-fourth of expected benefit (Hollaway, 2005). Finally, a more recent survey by Standish Group in 2009 discloses that over 65 percent of the sample IT projects failed in terms of three conventional measures (time, budget and benefits) (Masli et al., 2011).

The question of benefits from the IT investment was raised by Solow in 1987 when he said that "You can see the computer age everywhere but in the productivity statistics"; a statement that came to be called productivity paradox. Since then a significant number of articles has been written in an effort to explain the reasons behind the paradox. Brynjolfsson (1993) provides four potential reasons for PP; mismeasurement (input and output may be measured improperly), time lag (benefits from IT investment may be realized later rather than sooner), redistribution of profit (gain from IT investment can be positive for some firms and negative for others thus may not contribute to economic growth) and

mismanagement (can be linked to the inability and/or resistance by managers to transformational change through IT planning and implementation). A considerable amount of research has been empirically testing the PP. These empirical studies about PP show mixed results., Banker, Bardhan, chang, and Lin (2006), Navarrete and Pick (2003), Liu and Lu (2011) Mithas, Tafti, Bardhan and Mein Goh (2012) are among those who empirically reported a positive relationship between IT investment and productivity. In contrast, the majority of empirical studies such as Hitt & Brynjolfsson (1996), Devaraj, Krajewski and Wei (2007), Chatzoglou and Diamantidis (2009), Badescu and Garcés-Ayerbe (2009), Aral and Weill (2007) and Garicano and Heaton (2010) confirmed a negative or no productivity gain following the IT investments.

3.3.3. Risk-return and IT investment

Besides the mixed empirical evidence, investigating the risk-return profile of information technology investment (Dewan & Ren, 2011) find no significant correlation between IT investment and return. However, they report a significant positive association of IT investment with firm's risk level. The common practice of applying the weighted average cost of capital for discounting the expected return of all kind of capital investment (Dixit & Pindyck, 1995) without considering its associated risk might be misguiding when applied to IT capital investments. Such a practice of applying an average discount rate, which is too low given the riskiness of IT investment, will overstate the present value of estimated return from IT investment. So Dewan, Shi, and Gurbaxani, (2007) recommend a higher hurdle rate to properly and more accurately evaluating IT project alternatives. If this is the case then the increase in discount rate to evaluate IT projects will further decrease the return on IT investment, and as a result, many IT project may fall in the domain of PP, which makes it more difficult for managers to justify the investment in IT. Dehning, Pfeiffer and Richardson (2006) investigated the earnings forecast aspect of IT investment using IT spending data for over 1000 firms and concluded that IT investment increases the gap between actual and forecasted earnings. Wang and Alam (2007) investigated the IT capabilities, organizational ability to innovatively integrate the IT with other resources of an organization and conclude on a positive relationship between IT investment and future earnings uncertainty.

Table 3.1

Recent ERP project failure[2]

Organization name	Year	ERP project problems and failure
National Health Service (NHS) United Kingdom	2011	After spending about £12 billion (US$18.7 billion), NHS abandoned the project that was aimed at centralizing electronic health records of its citizens.
CityTime Payroll System project, New York the USA	2011	The project failed due to cost overruns, from budgeted $63 million to an estimated amount of $760 million, and a criminal probe.
Ingram Micro Australia	2011	The problem with SAP implementation at Ingram Micro led to a significant drop in its net income twice in the year 2011.
Montclair State University, New Jersey the USA	2011	PeopleSoft implementation at Montclair State University faced problems leading to University filing lawsuit against the Oracle for the botched implementation.
ParknPool, USA	2011	The furniture seller company sued Epicor over the failed ERP project
Marin County, California, USA	2011	Marin County filed a lawsuit against Deloitte Consulting and SAP over a failed ERP project
Whaley Foodservice Repairs, South Carolina, USA	2011	Epicor was sued by the commercial kitchens equipment company for a project which cost the company more than 5 times the original estimated amount of $190,000.
State of Idaho, USA	2011	Idaho state faced problems due to design defects and other issues that led various payment delays and faulty claims processing after installing a new system provided by Unisys. The state could suffer loss of millions of dollars due to the faulty Medicaid claims
Care Source Management Group, USA	2011	The group halted the ERP project and sued Lawson that to pay damaged of $1.5million as the software it provided didn't deliver the expected results.
The Victorian Order of Nurses, Nova Scotia, Canada	2011	The implementation of SAP's Payroll system resulted in the issuance of faulty paychecks to nurses for at least six months.
Lumber Liquidators	2010	Problems with SAP system were encountered.
Dillard's, Inc.	2010	JDA's i2 implementation failed to meet customer's expectations
Ferazzoli Imports of New England	2009	Epicor's system did not meet the customer's expectations as promised.

2 Source: Kimberling (2011) and Ram, Corkindale, and Wu (2013)

This means the IT investment increase the chances of error in earning forecasting of the IT adopters.

3.3.4. IT adoption

As an unmatched development in information technology constantly generates huge business opportunities along with considerable associated uncertainties, IT adoption has become the key to organizational success (Wu et al., 2012). Despite the academic literature's frequent claims that success levels resulting from the largest capital investment such as IT are far from satisfactory (Caldeira, Serrano, Quaresma, Pedron, & Romão, 2012), IT adoption has been growing every year over the past two decades. IT spending worldwide was estimated at $3.4 trillion in 2008 and with a temporary decline by 4.8 percent to $3.23 trillion in 2009 (Gordon, 2011). The predicted pace of growth in IT spending worldwide was set at 5.9%, 7.1% and 5% to hit $3.42 trillion, $3.67 trillion and $3.85 trillion in 2010, 2011 and 2012 respectively. Furthermore, in the most recent revision of these IT spending forecasts worldwide, Gartner Group reported a 5.2 growth in IT spending from 2011 to 2012. Moreover, the Gordon (2011) estimates a 5.3 percent compound annual growth rate in worldwide IT spending from 2010 to 2015 and his last estimate for 2015 is $4.44 trillion. Despite many problems of IT investment mentioned above such as mixed results in term of productivity and performance, higher reported failure rate, higher risk, and uncertain return in an ambiguously vibrant information environment, IT investment budgets by firm increases every year. What are forces that compel firms to invest in IT? Is there any cost of not to invest in IT, if yes has it ever been considered for the evaluation of IT projects? Is the cost of not investing in IT/IS such as ERP just equal to net benefit form IT/IS investment? What can be pros and cons of considering CNIIT? Next, we try to find out the possible answers to above questions.

3.4. IT-specific issues such as ERP system's ex ante evaluation

IT managers are frequently asked by senior management to provide a detailed ex-ante and ex-post evaluation for justifying and explaining the business impact information system (Torkzadeh & Doll, 1999). The result of the difference between ex-ante and ex-post analysis can be misleading unless it is assumed that the production without project will remain stagnant (Belli, Anderson, Howard, John, &

Tan, 2001). Ex-ante evaluation is the process of analyzing the anticipated impact of the planned program (Remenyi, 1999). The purpose of ex-ante evaluation is to support economic justification of the system based on financial estimates and ex-post evaluation usually assesses the financial and nonfinancial value of implemented system (Remenyi, 1999). However the value doesn't belong to the system implementation directly as mentioned above. Complexity related ex-ante evaluation of ERP software is to consider both qualitative and quantitative measures.

3.4.1. ERP's intangible costs and benefits

A high percentage of cost and benefits associated with ERP implementation is intangible. According to empirical evidence reported by (Brynjolfsson & Yang, 1997) up to 90 percent of costs and benefits of computer capital are embedded in intangible assets. For example soft investment, employees training and organizational transformational change made by IT investment create those intangible assets (Stefanou & Correspondence, 2001). However tangible and intangible costs and benefits should be taken into account for evaluating ERP investment alternatives. Tangible benefits such as cost saving from reduction in personnel for technical support, better inventory management, costs saving from not upgrading the legacy system etc. are easy to measure while other benefits such as value of real-time information for rapid decision making, perceived customer satisfaction etc. are difficult to calculate.

Tangible costs are dollars which a firm pays while developing, implementing and maintaining an information system. These costs include infrastructure development, consultant fee, maintenance cost etc. Intangible and/or hidden costs are also a major concern of ERP consultants because of the difficulty in identifying and/or measuring its magnitude. These costs include underestimation of time required to complete implementation of ERP, lack of commitment from top management, user resistance to such revolutionary change etc. (Stefanou & Correspondence, 2001). Even though it is difficult to measure intangible costs and benefits of information systems, it can be managed through tying up those with executive's incentive plan.

3.5. With and without analysis

With and without analysis provides the actual value of a project because it takes into account the

incremental value created by the potential project. Normally, it is not the same as a comparison between

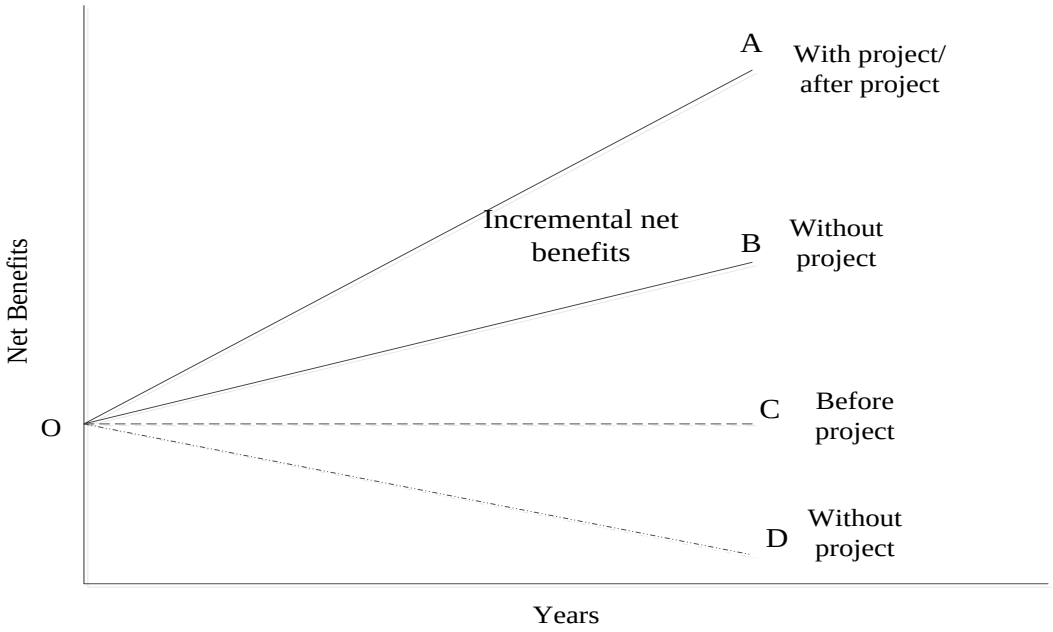


Figure 3.1: With and without and before and after project comparison

before and after project. With and without analysis is superior to a comparison between ex-ante and ex-post situation because with and without project analysis considers the change in net production takes place if the firm decides to not invest. In contrast, the before and after analysis fails to consider the change in production that would occur without the project (Belli et al., 2001) for example if the firm decides not to invest yet it has to move with changes in production. As figure 3.2 depicts that change in net benefits can already take place even if the production is increasing or decreasing. The net incremental benefits from the project within a particular period of time, as illustrated in figure 3.1, are the difference between B and A. For example, when the net benefits were estimated to increase by 2 percent without a project and 6 percent with the project, the net incremental benefit would be 4 percent. However, before and after analysis would attribute the whole 6 percent growth in net benefit (depicted by area AOC in figure 3.1) to the project. If net benefits are estimated to decline at point D without project, for example, the actual value of the project would be the difference between A and D, not the difference between A and C. There is no difference between the “with and without” and the “before and after” analysis if it is assumed that the net benefits will remain stagnant without project. Because of the superiority of with and without analysis we apply this concept on ERP

investment evaluation model in figure 3.1. (Hunton et al., 2003) empirically tested the performance of ERP adopting (three years before and after adopting ERP) and non-adopting firms and found a diminished performance of non-adopting and unchanged performance of adopting firms. In this case, the benefit of ERP can be measured through peers' performance review of firms without ERP thus the benefit may be equal to the difference between the stagnant performance of firm with ERP and declining performance of firms without ERP. Contrary to this de Andres, Lorca, and Emilio Labra (2012) empirically investigated the impact of ERP implementation on the profitability of big firms in Spain and found a significant reduction in the profitability of ERP adopters as compared to non-adopters. The may be because of many reasons such as disturbance during ERP implementation, time lag before realizing ERP benefits, not considering whole life of ERP.

3.6. Competitive forces and effect on market share

Let us assume that in a growing market, firms have two options. Option 1: invest in IT and get "0" return and Option 2: not to invest in IT and get "5". For a monopoly selecting option 2 may be a good decision. Can it be justifiable in an oligopolistic competition such as duopoly (forms of oligopolistic competition in which only two competitors exist in an industry) if firm selects option 1? The answer may not be as simple as it seems because there are many factors such as economic conditions, competitors' strategic actions, etc. that need to be considered. For simplification, we further assume the conditions in figure 3.2 where firm A and firm B have to decide between invest in IT or not to invest in IT. It can explicitly be recognized that the Figure 3.2 has been drawn on Game Theoretical ground. Review of past studies on effects of ERP implementation reveals that the costs, but also possible benefits, of not implementing an ERP system (while competitors do) need to be considered when evaluating the ERP system implementation investment decision. The questions are very simple; like what should firm A do if firm B doesn't invest and vice versa? What should firm A do if firm B is investing and vice versa? The answer should be "yes should invest" in either case for both firms because if firm A does not invest in IT and firm B does then benefit from not investing in IT for firm A would

be equal to 5 but the net loss of market share can be equal to 10 (15 - 5) as mentioned in figure 2.2, therefore, firm A will definitely invest too.

Following (Tangpong, 2002) we apply the prisoners dilemma matrix (called IT investment matrix in our case) to demonstrate the effect of competition on the market share and hence on performance. If we analyze the IT investment matrix closely in figure 3.2, we see that if any firm is not investing in IT, it does not affect its benefit, which remains, irrespective of the fact that the investment in IT is made by its competitor or not as shown by 5 for firm A and 5 for firm B at ① . Mark, Rajiv, and Nan (2002) find that peers' IT investment does not affect the IT value of the firm but what will be the consequence if firm decides to share IT value (benefit) with consumers?

Tangpong, (2002) finds that IT investment does not add value to the investing firms. He provided support to our view that not investing in IT can even be worse in term of value addition. The finding of (Tangpong, 2002) can also be true in the country where there is unstable economic environment such as Pakistan. However the cost of not investing in country as Pakistan where there has been unstable economic condition the cost of late or not investing in IT can negatively affect the financial performance of the firms.

If this is the case then why should any of the firms invest? If we compare the 1 & 4 in figure 3.2 we see that at 4 both invest and getting zero additional profit but at 1 both firms do not invest and get 5 additional profit. Is it not better to stick with the decision of not to invest? The answer may be "no" because if any of the competitors invests in IT then the other has to bear the 20 percent potential loss of market share (hence net profit = 5-10 = -5 net overall profit of the firm) which is more than the benefits as depicted in figure 3.3 "Market share at 2 and 3".

Even though both firms know very well that if any of them invests, other must invest and additional gain will be equal to zero for both firms, making an investment in IT is a better decision than not to invest in order to avoid bigger potential loss in term of diminished market share. Here the intention of the IT investment is to save bigger potential loss even at the cost of benefit from not investing.

In this era of information technology and the nature of its investment, considering only benefits from IT investment may not be sufficient to justify its investment in IT. Gunasekaran et al. (2006) recognize that most firms tend to focus more on benefits than total costs, therefore failing to consider the total relevant costs of IT.

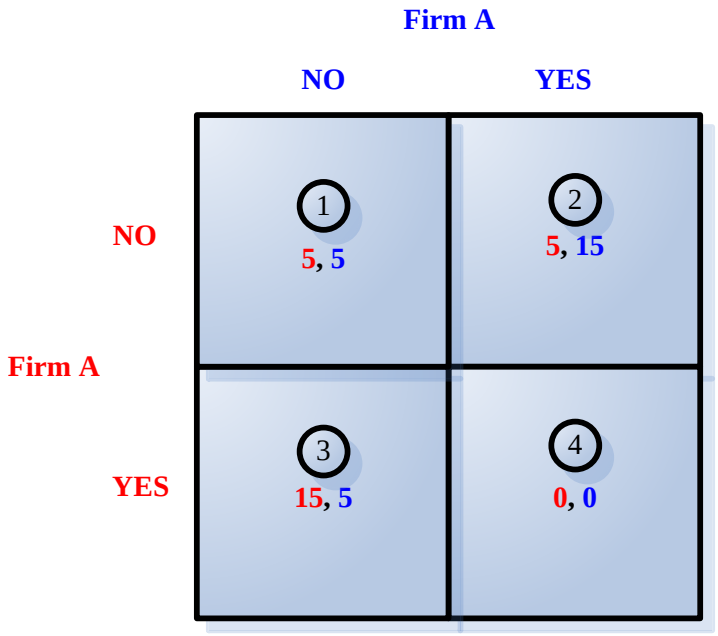


Figure 3.2: IT investment and firm performance matrix

Assumptions:

- *Both firms have an equal market share and any difference of gain between A and B will bring the corresponding percentage of change into its market share.*
- *Figures in the investment matrix are marginal net profit and their existing net profit is 5 for each firm.*
- *1 If both firms do not invest in IT, they get the equal additional benefit at 50 percent of potential benefit in growing market.*
- *2 and 3 show that if any of both firms invests in IT and the other one does not, the investing firm reaps 75 percent of the additional potential benefit.*
- *4 If both firms are investing and it is assumed that it triggers the price war between the firms and benefit from opportunity is transferred to the end user in an effort to capture market share, both are getting zero additional benefits.*

Managers also need to consider the CNIIT which can be many times greater than that of potential benefits from IT investment. Whether or not to invest in IT is a very difficult decision (Chou et al., 2006). Even though there are uncertainties of return and a colossal amount of money is required, firm can't afford not to invest in IT (Escobar-Perez, 1998) because IT can improve the effectiveness and

efficiency of an organization, it can provide competitive advantage (Irani & Love, 2002; Powell, 1992) and it also offers new ways of managing the organization and developing new businesses (Powell, 1992).

Gunasekaran et al. (2006) argue that managers may believe that not to invest in IT can be unaffordable because of competitive reasons. On the other hand, they can't present sufficient arguments to justify their IT investment decision. In this condition not considering CNIIT can lead to wrong and unjustifiable IT investment decision. We develop IT investment valuation and justification model (ITIVJM) in figure 3.4 to address PP and IT investment justification problems by considering costs and

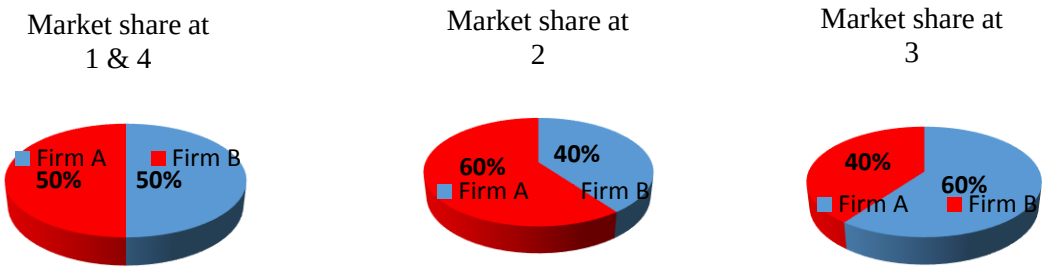


Figure 3.3: Impact of IT investment on market shares of firms

benefits of not investing in IT. Even though CNIIT can be considerably greater than the benefits of IT investment, to the best of our knowledge, it has hardly been used by any project evaluation technique. We strongly recommend considering not only the costs but, also the benefits of not investing in IT while evaluating IT investment or any such kind of investment project where the cost of not investing is not equal to benefits of not investing in it.

3.6.1. IT investment valuation and Justification Model (ITIVJM)

As mentioned in chapter 1, consistent with our example the studies by (Hunton et al., 2003) and (de Andres, Lorca, & Labra, 2012) empirically reported positive and negative effect of specific type of IT/IS such as ERP, as compare to their non-adopting peers respectively. Both of studies compare the pre-to-post performance of ERP adopters with that of non-adopters in the same period, while controlling the performance, industry and size effects. Both of studies find contradictory results. (Hunton et al., 2003) report significant positive performance of adopter as compare to that of matching non-adopter.

Such a relative positive performance of adopters was not because of their improved financial performance in post ERP implementation period but it was because of decrease in financial performance of non-adopters which is called cost of not investing in IT/ERP for non-adopters. (de Andres, Lorca, & Labra, 2012) find significantly positive performance for ERP non-adopters as compared to that of adopters. Such a relatively impaired performance of ERP adopters was because of their diminished financial performance but not because of improvement in financial performance of adopters. Given the importance of considering costs and benefits of not investing in IT, we propose a new evaluation model and set the criteria to accept or reject a particular IT/non-IT project using the assumed data in figures 3.4 and 3.5 respectively. As mentioned in figure 3.4, the ITIVJM consist of a sequence of three simple steps: firstly, identify the costs and benefits of IT projects along with cost and benefits of not investing in IT projects, secondly, compare the costs and benefits of investing in IT and not investing in IT separately, finally compare the results calculated at the second step. Once we complete the evaluation of IT projects we will be better able to see the actual value of each project to select the best one on the basis of actual value.

There is a need to discuss the costs and benefits of not investing in IT because costs and benefits of investing in IT have widely been discussed in the literature, but hardly any studies include the costs and benefits of not investing in IT. Benefits of not investing in IT may include a return from investment in another non-IT project such as risk-free return from more liquid securities such as T-bills, certificate of deposit etc., the gain of market share from investment in the non-IT project and so on. Costs of not investing in IT may include a missing opportunity for transformation, loss of market share, loss of future opportunities based on the IT and so on.

Considering the cost and benefits of not investing we have developed criteria to accept or reject any project in figure 3.5. It says that any IT project should be accepted on the basis of the difference between costs and benefits of investing versus costs and benefits of not investing. Minimizing the loss is also equal to maximizing the profit as a calculation in figure 3.5 depicts. Empirical evidence also suggests that despite no value addition of investment in IT, firms have increasingly invested in IT to minimize

the potential loss. According to figure 3.5, the firm should invest even though the firm does not expect any profit from the investment, yet investment can save a potential loss of 10.

3.6.2. Integration of ITIVJM and NPV

We integrate ITIVJM with NPV because NPV has not only the strongest recommendation for evaluating IT and non-IT projects by researchers, but it is also one of most used project evaluation techniques in practice, whereas real option (RO) is hardly used by decision makers in practice. Furthermore, an extension of the method presented here to RO is straightforward.

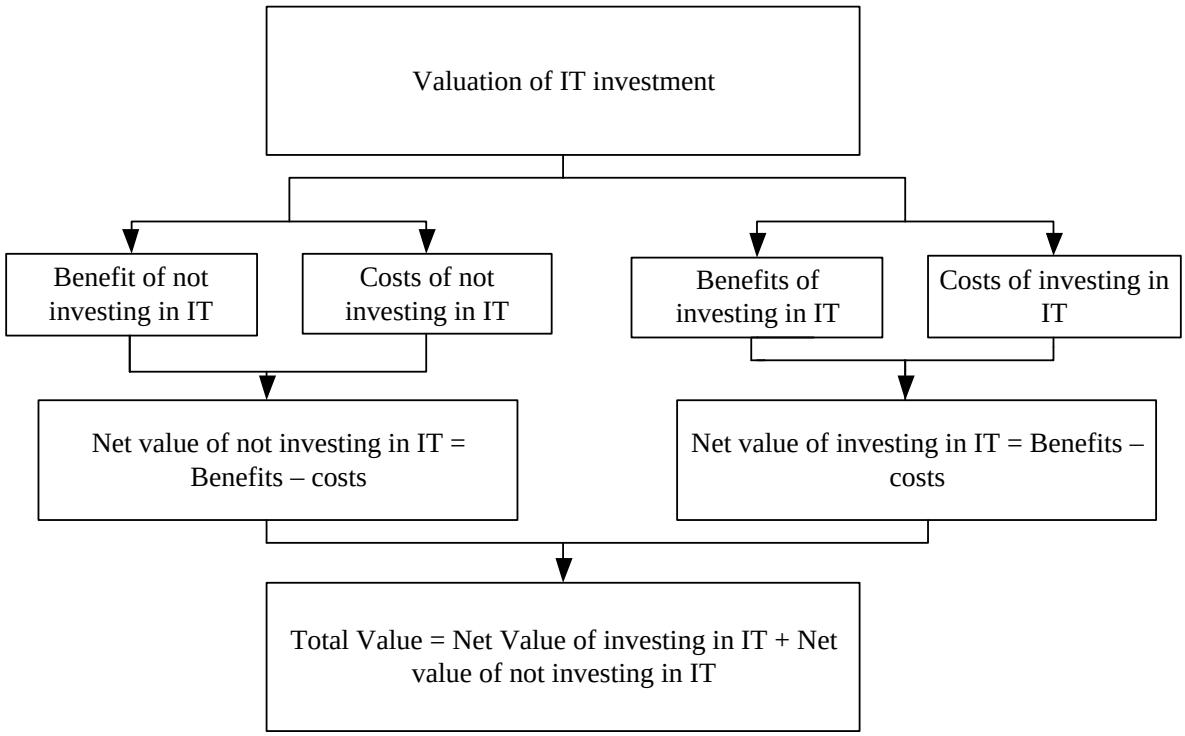
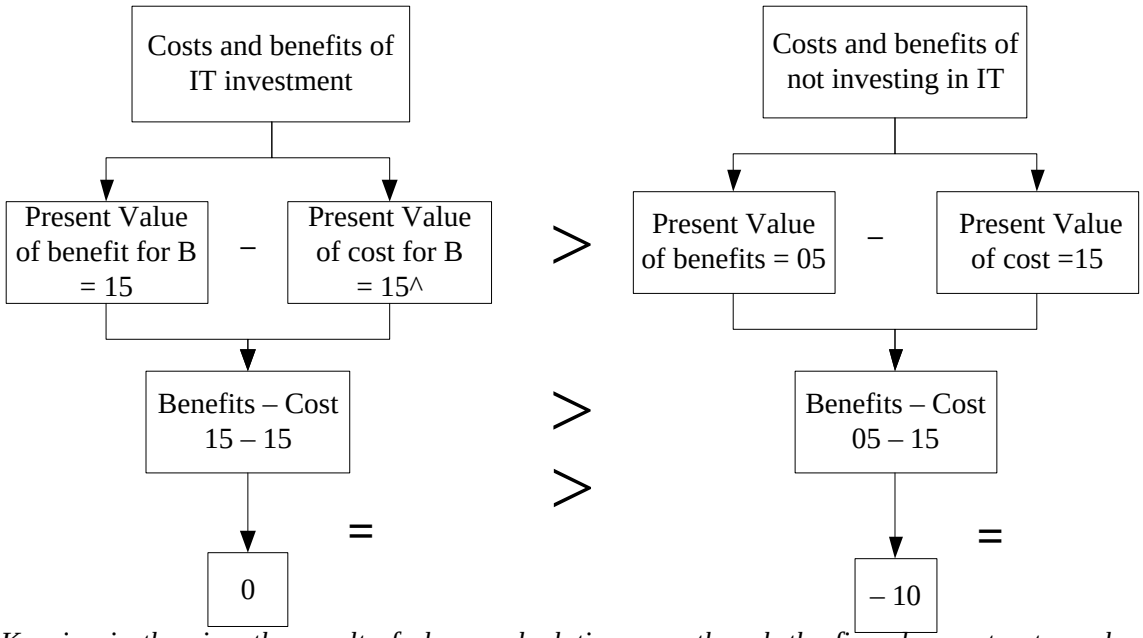


Figure 3.4: IT investment valuation and justification model

According to a survey conducted by (Graham & Harvey, 2001) in the US, 74.93% of 392 American companies always or almost always use NPV. Ryan and Ryan (2002) found 85.1% of the sample firms always or often use NPV against 1.6% of firms using RO. Leon, Isa and Kester (2008) find that 86.4% of the firms have been using payback period followed by 63.6% and 63.6% of the sample Indonesian firms relying on NPV and IRR respectively to quantify capital budgeting projects. More recently Shinoda (2010) conducted a survey to know the frequency of use of capital budgeting methods in Japan

and found that NPV is the second most preferred tool with 30.5% of firms always or often using it as compared to only 0.5% for RO.

Despite the fact that researchers have recommended RO for years, research shows it is used by 0 to 2 percent of firms to evaluating major capital expenditure such as IT. Therefore, we decided to integrate ITIVJM with NPV; we call it Integrated NPV for IT (INPVIT).



Keeping in the view the result of above calculation even though the firm does not get any benefit from investment in IT yet it can save the loss of 10 by making an investment in IT. Therefore, the project should be accepted if the benefit and cost of investing in IT are greater than benefit and cost of not investing in IT.

^ We assume here the cost of investing in IT is equal to 15.

Figure 3.5: Criteria to accept or reject the IT project base on proposed model and example

$$\text{NPV} = -C_0 + \sum_{i=1}^{T} \frac{C_i}{(1+r)^i} \quad \text{.....1}$$

$$\text{INPVIT} = -C_0 + \sum_{i=1}^{T} \frac{C_i}{(1+r)^i} \pm \sum_{j=1}^{T} \frac{C\hat{}j}{(1+r)^j} \quad \text{.....2}$$

Where,

C_i = Expected cash flow (absolute value) in period i

$C\hat{}j$= Estimated costs (benefits) of not investing in period j

T = Total time period

i = Period of time in which cash flow occur

j = Period of time in which costs/benefits of not investing occur (may be different from i)

r = required rate of return or discount rate

$\pm$ = When there is net benefit of not investing in IT the last part in equation 2 will deducted and vice versa.

Equation 1 shows the simple net present value formula where initial costs and the present value of expected benefits are compared, the maximum positive value can be accepted, rejected otherwise. But like other traditional and non-traditional capital budgeting evaluation tools, NPV assumes that costs and benefits of not investing in any project are equal. As mentioned above, we strongly argue that cost of not investing in IT can be beyond the level that the firm may afford because of competitive reasons. Therefore using the technique for IT project valuation that does not include the cost of not investing in IT may not provide the real value of projects to select and justify it. We integrated our idea into the NPV formula depicted in equation 2 where we additionally included the present value of cost or benefit of not investing in IT.

3.7. Numerical example

A numerical example given in table 3.2 considers two mutually exclusive projects one of them is an IT project and the other is a non-IT project that requires not only a similar amount of investment but also offers similar future cash flows. Ceteris paribus, no traditional capital budgeting techniques including NPV can decide between the following two projects but INPVIT. Let's further assume the cost of not investing in IT and non-IT is as given in table 3.2 for every year through the life of projects. What could distinguish the IT-project and the Non-IT project? According to Dixit and Pindyck (Dixit & Pindyck), while evaluating the IT projects, the managers should use a higher hurdle rate because of its associated higher risk than non-IT projects. In the example, if we use different discount rates for IT and non-IT projects, a higher discount rate will make IT project even less attractive than a non-IT project. Under the given circumstances what motivates managers to make the irrational decision of investing in IT instead of the non-IT project? One could say that it is the qualitative value of IT investment such as

better information flow, better control, business goal etc. that makes the difference between two, but translating those qualitative benefit is very difficult (Angelou & Economides, 2009). Similar to qualitative benefits there can be hidden costs (Milis & Mercken, 2004) which are often difficult to identify. However, empirical evidence suggests that investment in IT is less productive, non-productive or even counter-productive in some cases. It means that using different hurdle rates for IT and the non-IT project does not address the IT investment justification problem.

Table 3.2

A numerical example considering CNIITP and its solution

This table show the assumed numerical example which depict the how the decision can change if the cost of not investing is considered. Column 1 show the year which ranges from zero which means today to three which means three years from today. Column 2 shows the cash flow from IT project for specific period. Cost on not investing may be in form of deprivation of future opportunity or possible cost reduction etc. is represented by column 3. Columns 4 and 5 represent the cash flow from non-IT project and cost of not investing in non-IT project respectively. r is required rate of return and WACC is weighted average cost of capital.

Year	IT Project (C)	CNIIT $C^{\wedge}$	Non-IT Project	CNINIT
0	-100		-100	
1	30	10	30	0
2	50	20	50	0
3	80	20	80	0
NPV at r = 10%	28.70	40.65	28.70	0
NPV at r = 20% WACC	6.02	33.80		0
INPVIT at 10% WACC	69.35		-11.95	
INPVIT at 20% WACC	39.81			

Analyzing the solution numerically shows that the NPV is 28.7 for both projects at 10 percent weighted average cost of capital (WACC) in table 3.2 thus deciding between these two projects based on NPV is not possible. We have included the cost of not investing in IT to make a decision based on calculation according to INPVIT. We call it actual expected value of the project, instead of undervalued IT projected (value of projects based on NPV calculation). For finding the actual value of a project first, you need to find the NPV of a project, second calculate the present value of the net benefit or cost of not investing in IT, final add the present value of total net cost (subtract if net value is a benefit) of not investing in IT to NPV. So the actual value of IT project at 10% discount rate is 69 (28.7+40.65) as compared to the actual value of Non-IT project at 28.7. Why is the value of 40.65 added into NPV of IT project? The addition of 40.65 into NPV of IT project can be interpreted as if a firm chooses to invest

in IT; it gets not only benefit of investment in IT (28.5) but also saves itself from potential loss from not investing in IT project. If this is the case then why do we subtract the PV of the cost of not investing in IT (40.65) from NPV of Non-IT project (28.7)? We are doing so because the projects are mutually exclusive. It means if we invest in non-IT we can't invest in IT and vice versa. As mentioned above following the strong recommendation of (Dewan, Shi, & Gurbaxani, 2007) to set higher hurdle rate for properly evaluating the IT project alternatives we doubled the discount rate for IT project at 20 percent and kept discount rate unchanged at 10 percent for the non-IT project. At this point NPV says to accept the non-IT project instead of the IT project because after applying 20 percent discount rate for IT project, the NPV for IT project become 6.02 (at 20 percent discount rate because of higher associated risk with IT projects) as compared to 28.7 (at 10 percent discount rate because of less associated risk of non-IT project) for non-IT project where the verdict of INPVIT is unchanged because after changing the discount rate at 20 percent only for the IT project, the actual expected value of the IT project becomes 39.81 as compared to -11.95 for non-IT project. Not including such a big cost of not investing in IT while evaluating mutually exclusive IT and non-IT investment projects can lead firms to select a wrong project, therefore, we strongly recommend to include the costs/benefits of not investing in IT into the project evaluation process.

3.8. Discussion

An important question left is how to identify the costs of not investing in IT and how they can be measured. The importance of IT investment for at least protecting the current competitive stance of a firm is unambiguously recognized by businesses and researchers. The cost of not investing in IT can be the potential loss of market share (as depicted by example 1) and deterioration of the competitive position of the firm. Investment in IT helps businesses in diverse ways. The world has developed into a global village with the help of IT which has not only brought the countries closer together but also allows the world's economies to develop a single interdependent system. Not investing in IT throws the firm out of that global village. IT helps in making communication quicker, cheaper and more effective and efficient, e.g. using video conference and email via the internet. IT helps businesses to bring cost efficiency through computerizing their business process. IT allows businesses to remain open 24/7 thus

it makes businesses to be in operation all over the globe through online facility. Not investing in IT will deprive the firms to take these benefits. Investment in IT allows the firm to develop a better control e.g. minimizing number of frauds. The cost of not investing in IT is equal to not having all above benefits. If firms invest in IT and get no productivity/profitability then imagine what could be the position of a firm if it does not invest!

Measuring the cost of not investing in advance is depending upon estimation in almost all above cases. We can measure the communication costs of not investing in IT by comparing the total costs of communication with stakeholders without IT that may be removed with IT investment. The cost of not have a better control system based on IT investment for controlling the fraud in business may be equal to the number of frauds takes place in a particular period multiplied by the average magnitude of fraud for example. IT investment is portrayed as the mean of achieving and or sustaining the competitive stance of a firm. In this era of IT, the cost of not investing in IT may be huge. No IT investment may make it difficult for the firm to survive. CEOs of a firm can estimate this kind of cost based on their experience and foresightedness.

Like every model, ITIVJM has also some limitations. ITIVJM cannot be applied if the cost of not investing is equal to benefits of not investing in IT however the ITIVJM can also be used if two or more mutually exclusive IT projects are analyzed. The cost of not investing in IT can be difficult to estimate. INPVIT has all the limitation of NPV because we have integrated ITIVJM model and NPV such as difficulty in estimating discount rate, managerial flexibility etc. because of environmental dynamism (but the problem of managerial flexibility can be addressed through the integration of ITIVJM and RO). ITIVJM has not yet been validated through real world data so far and we intend to do it next.

3.9. Conclusion and Recommendation

In this information era, the role of IT on sustainability and growth in a severely competitive environment has achieved more prominence. The chief executive officers seem very serious to incorporate the IT into their strategic decision-making process for getting a competitive advantage. Despite higher unsatisfactory performance rate of IT investment has been reported, almost every firm (irrespective of

its size, nature of business, sector etc.) is taking the part in the race of IT investment to such an extent that IT investment has become the largest capital expenditure for many firms. Therefore selecting an IT project from available alternatives is crucial and a difficult decision because of its special properties such as higher associated risk, uncertain return etc. Decision makers can't think not to invest in IT because they may believe that firms cannot afford it, this means the CNIIT is huge enough to leave no option to the firms but to invest, irrespectively to its promised trifling and unjustifiable benefits that have rarely been realized by firms. Including CNIIT can reveal very interesting insight into the literature of IT investment valuation. To the best of our knowledge, all the traditional tools such as payback (PB), internal rate of return (IRR), NPV etc. and other tools such as analytic hierarchy process (AHP), RO etc. for evaluation of IT project assume that CNIIT is equal to benefits of not investing in IT which by no means can be equal as mentioned above. Not including such a huge CNIIT may lead firms to make unjustifiable and wrong selections of IT investment projects. A solid and easy to use technique has still been waited for by managers for not only selecting the proper project but also for justifying their decision. Therefore, we propose a complete model that takes into consideration both costs and benefits of investing and not investing in IT. Our Proposal has enough potential to make a useful contribution to the literature of IT investment valuation through identifying the costs of not investing and shedding light on importance of including the cost of not investing (in IT) into valuation model to guide the managers to not only make correct selection but also be in a strong position to justify their selection. We decided to integrate our model with one of most useful traditional capital budgeting tools such as NPV and we call it INPVIT. We recommend that CEOs should consider costs and benefits of not investing in IT in order to make an effective, efficient IT project selection. We intend to validate our model through some real world data in order to overcome the assumptions.

Chapter 4

Variables and Hypotheses

4.1. Objective of the chapter

The purpose of this chapter is to develop the hypotheses in accordance with the research questions posed in the first chapter of this study. The variables (dependent and independent) will be identified and defined in order to test the hypotheses. We enlighten the type and nature of data that has been collected through diverse sources. The reader of the data section will easily be able to guess the cause behind no research work to empirically test the performance impact of ERP on adopters and non-adopters. Issues and solutions related to data will be elaborated then. At the end of this chapter, the research methodology will be enlightened.

4.2. Hypotheses

We have developed hypotheses about the expected behavior of selected variables in this study. The justification has also been given from literature to hypothesized change in variables.

4.3. Independent variable

We selected ERP implementation status of the firm as an independent variable following (Etezady, 2008). We separated the institutions that have deployed ERP system (thereafter ERPs) from those firms that have not. This independent variable is with two stages. Stage one relates to companies that have deployed an ERPs or ERPs modules and stage two correspond to firms that have not implemented an ERPs or modules of an ERPs. The ERPs deploying firms then were included into ERP adopting group and an accordingly nonadopters group of firms is developed in this study. The procedure to find comparable firm is given below.

4.4. Dependent Variables

Schryen (2013) reviewed more than 200 research papers on business value of IS and argued that most of the studies on financial performance impact of ERP could consider the profit ratios as compare to very low number of studies that include the cost ratios and turnover ratio. Consistent with Schryen

identification, analysis of recent literature as given in the table 4.1 reveals that the majority of studies have included mainly profitability ratios. ROA ratio has highest frequency of 12 out of 16 studies in table 4.1 used ROA as surrogate of profitability whereas selling general and administrative costs and operating income are the least frequent variables used by any studies in tables 4.1.

To fill in such an important gap a decent number of variables have been identified for an in depth analysis of performance effect of ERP. By in depth analysis means it is being tried in this study to find what actually leads the change in any of profitability variables. We got the help from literature in identifying the different variables.

Table 4.1
Summary of financial performance variable

The purpose of this table is to summarize the financial variables that have been used by previous studies, we don't consider the nonfinancial variables in this table. Column 1 shows the financial variables and columns 2 to 17 represent the different studies that have used the different financial variable for testing the impact of ERP on post/relative post implementation performance of firms. F helps in determining the frequency of each variable that has been used by studies. N shows the maximum number of financial variables used by any study. where 1 = (de Andres, Lorca, & Labra, 2012), 2 = (Etezady, 2008), 3 = (Liu et al., 2008), 4 = (Nicolaou & Bhattacharya, 2006), 5 = (HassabElnaby, Hwang, & Vonderembse, 2012), 6 = (Hendricks et al., 2007), 7 = (Hitt et al., 2002), 8 = (Hunton et al., 2003), 9 = (Kallunki et al., 2011), 10 = (Kouki, 2015), 11 = (Su, Chang, & Chen, 2013), 12 = (Parto et al., 2016), 13 = (Poston & Grabski, 2001), 14 = (Shaukat, 2009) , 15 = (Voulgaris, Lemonakis, & Papoutsakis, 2015) and 16 = (Wier, Hunton, & HassabElnaby, 2007). x is indication if any of studies used any of listed variables.

Financial ratios used in this study	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	F
ROA	x	x	x	x	x		x	x			x	x		x	x	x	12
ROIC	x	x		x				x				x		x			6
ROE							x				x			x			3
ROS		x	x	x				x			x				x		6
TAT	x					x	x	x			x	x		x	x		8
SG&A				x													1
COGS		x	x	x									x				4
ARTO							x				x						2
ITO							x				x			x			3
PM	x			x			x					x					4
OI	x																1
SG	x					x			x	x						x	5
Number of Employee				x		x			x				x	x			5
Equity Market value						x	x										2
Lev.							x			x						x	3
Size								x	x	x						x	4
OX											x		x				2
Market share														x			1
N	6	4	3	7	1	4	8	4	3	3	6	4	3	7	3	4	

Where ROA = return on assets, ROIC = return on invested capital, ROE = return on equity, ROS = return on sale, TAT = total assets turnover, SG&A = selling general and administrative expense, COGS = cost of goods sold, ARTO = account receivable turnover, ITO = inventory turnover, PM = profit margin, OI = operating income, SG = Sales growth, Lev. = leverage of the firm and OX = operating expense.

4.4.1. ERP and profitability

ERP investment promises the sale growth and cost reduction, hence it increases the adopting firms' profitability. However, the empirical results of the ERP impact on firm performance are mixed. It is worth to note as Hitt et al. (2002) observed the reduction in firm performance immediately after the completion of ERP implementation, but the empirical study by Hunton et al. (2003) is suggesting that this decline in performance is temporary and company started to regain performance in a two-year post-implementation period. Amid et al. (2012) argue that higher cost and complexity associated with ERP systems frequently leads to serious failure. Kwahk and Lee (2008) report that estimated failure rate of ERP system is higher than 60 percent. It is not the ERPs system software that brings the benefits for companies but the changes associated with ERP system that offer benefits (Donovan, 2000). However, these changes have frequently proven overwhelming in many firms that resulted in ERP project failure (Maguire, Ojiako, & Said, 2010). While reporting the Spanish firms' performance after ERP implementation de Andres, Lorca, and Labra (2012) find a negative impact of ERP system implementation on firm performance. The major concern of ERP system is its failure rate in term of time, budget and expected benefits however many recent studies empirically report the significant positive performance effect of ERP system either through cost reduction or through revenue growth. Hitt et al. (2002) empirical investigate the pre and post ERP implementation impacts on firm performance and find the significant positive effect of ERP on post-implementation performance. Hunton et al. (2003) investigated the effect of ERP system adoption on firm performance of adopting and non-adopting peers and empirically found significant positive effects on ROA, ROI and ATO for ERP system adopters as compared to that of comparable non-adopters. While investigating the impact of enterprise systems such as ERP, SCM and CRM, Hendricks et al. (2007) find not only statistically significant and strong positive relationship between ERP and firm performance but also they confirm no negative relationship between any enterprise system and firm performance. Mithas et al. (2012) empirically report the positive relationship between ERP system implementation and firm performance which is triggered by sale growth instead of cost reduction. Rozenes, Kukliansky, and Vitner (2014) investigated the impact of successful implementation of ERP system on financial performance and find

a positive correlation between ERPs implementation and firms' performance. We have observed that a huge number of studies report a significant positive impact of ERP on firm performance. In more recent studies they include (Anderson et al., 2011; HassabElnaby et al., 2012; Kallunki et al., 2011; Kouki, 2015; Lunardi, Becker, Maçada, & Dolci, 2014; Voulgaris et al., 2015).

H1a: Compared to pre, ERPs adopters' performance declines in average during and recover in post-implementation periods in term of return on assets (ROA), return on invested capital (ROIC), return on equity (ROE) and return on sale (ROS) in post-implementation period.

H1b: Adopters perform better in term of ROA, ROIC, ROE, and ROS, in post-implementation period than that of their matching non-adopting firms

4.4.2. ERP and Cost Reduction

Real-time information and automation help the firms to reduce the cost in numerous ways. ERPs enables simultaneous access to a central database that keeps the different departments alert to react at the same time to certain tasks hence it creates efficiency in the organization.

IT investment, if handled properly, generates dual effects. It can not only facilitate higher sales as mentioned above but also it decreases the costs. IT investments have evidenced efficiency through supporting the lean transformational process of operational and supply chain management within and across the firms (Ilebrand, Mesoy, & Vlemmix, 2010). Deployment of ERPs in the firms is associated with higher productivity and improved inventory turnover thus diminishing the operational cost (R. D. Banker, Bardhan, & Asdemir, 2006; Mukhopadhyay, Barua, & Kriebel, 1995). ERPs deployment injects the efficiency through reducing coordination cost by ensuring the tighter coordination among the departments that allows firms to react simultaneously to certain condition (Banker et al., 2006; R. Kohli, 2007; S. Mithas & Jones, 2007; Whitaker, Mithas, & Krishnan, 2010). ERPs facilitate the firm to reduce the costs associated with firms IT infrastructure by replacing ERPs for the scattered legacy systems (Shang & Seddon, 2002). Improved reaction time triggered by ERP implementation to fulfill the customers' orders facilitates the firm to reduce the inventory stock which results in enhanced inventory turnover. Holding less volume of inventory requires fewer workers to deal with thus reducing

the labor cost as well as monitoring cost required to supervise the activities of decreased number of workers. If sometimes firm is facing unusual condition such as fulfilling a big order which demands more workers for a temporary time, timely information through ERP's central database allows the HR department to hire the laborers at competitive market price thus decrease labor cost. IT investment helps the firms to reduce the agency costs in two ways. First, Real-time data and automation and tight integration make it difficult for managers to manipulate accounts to show the larger profits and higher company performance at the end of fiscal year. Hence, deployment of ERPs can pacify the agency conflict between managers and stockholders. Second, reduction in costs requires less capital to support firms' operations thus firm can reduce the borrowed amount or it can be used for additional productive activities. Therefore, ERPs implementation mitigates agency conflict between shareholder and creditors of the firm.

H2a: Compared to pre, ERPs adopters perform better in term of total asset turnover (TAT), and inventory turnover (ITO) in post-implementation period.

H2b: Adopters perform better in term of TAT and ITO in post ERPs implementation period than that of their non-adopting matching firms.

H3a: Compared to pre, ERPs implementation negatively affects adopter's operating expenses (OX) and cost of goods sold (COGS) in post-implementation period.

H3b: Adopters perform better in term of OX and COGS, in post ERPs implementation period than that of their non-adopting matching firms.

H4: Compare to pre, the size of ERPs adopters increase in post-implementation period.

4.4.3. ERPs implementation and capital structure

ERP implementation has been cited by many researchers as a large investment. The major costs and benefits emerge from organizational changes induced by ERPs are greater than that of just using the ERPs software (Donovan, 2000). The IT investment such as ERP is considered as a risky investment, if not managed properly, it can cost millions of dollars and lowered financial performance that may impair the reputation of the firm in the market. A higher degree of risk, involved in ERP

implementation, increases the chances of bankruptcy for the firm thus it disturbs the optimal capital structure level of the firm (Ali, 2011). According to tradeoff theory of capital structure, the higher the bankruptcy cost, the lower the leverage level and vice versa. Beside this, tradeoff theory of capital structure predicts that firms have target leverage ratio to maintain. Firms start moving toward its targeted capital structure if it is disturbed by certain investments such as in ERPs. According to the hierarchy suggested by Pecking Order Theory, profitable firms prefer the cheapest source of capital such retained earnings and then debt and if it is still needed for capital than firms issue equity. To avoid the higher risk, bankruptcy cost and mitigating agency relationship firms need to less depend on debt during implementation and the successful implementation may allow firms to readjust their capital structure in post ERPs implementation period for getting a maximum tax benefit from optimal capital structure. Thus, we expect following relationships between firm performance and debt equity ratio.

H5a: ERP implementation negatively affects adopters' DER during the implementation period.

H5b: Adopters' DER decline during ERPs implementation period as compared to that of the non-adopting matching firm.

4.4.4. ERP and Revenue Grow

Investment in information technology enables sales growth through on time delivery, new advertising, marketing and sales channels, improved customer service and better management of customer life cycle. ERP has been well recognized globally as a system that is providing real-time data. The access to real-time data diminishes the time period required to fulfill the order thus improving the on-time delivery and customer satisfaction. Information technology allows the firms to better understand the customer's need through disseminating information and one on one communication. Better knowledge of customer's need and diminished order processing time enabled by IT systems such as ERP, CRM etc. facilitate the firms to offer new customized product and services as a result, this will lead to improved customer response (Ansari & Mela, 2003) and better one to one marketing effectiveness (Mithas, Almirall, & Krishnan, 2006). Velcu (2007) reports that ERP adopters provide more accurate price by diminishing the mistakes in invoiced price may lead to growth in revenue (Kallunki et al., 2011).

Information Technology enables the firms to develop new marketing, advertising and sales channels for making their existing and potential customer better aware about their products and services offerings. The new IT-enabled channels such as emails, web advertising, websites, short messaging system and targeted database allow the firms to target the potential customers thereby improve the firm revenue (Mithas et al., 2012).

IT improves the management of customer lifecycle through providing support at each step from awareness to improved customer satisfaction (Bardhan, 2007; Srinivasan & Moorman, 2005). The improved customer satisfaction will generate loyalty and willingness to pay which finally lead to higher sales growth (Babakus, Bienstock, & Van Scotter, 2004). Mithas et al. (2012) investigate the impact of IT investment, as compared to other discretionary intangible investments such as research and development and advertising, on profitability and they empirically report a significant positive association between IT investment and profitability. Furthermore, they argue that return on IT such as ERPs is higher than that of other discretionary investments. The only source of higher return on ERPs investment was sales growth. Reduction in time required for producing goods and services can bolster timely fulfillment of an order that can reduce the customer complaints, strengthening the customer relationship and it can, in turn, increase the revenue of the firm.

H6a: Compared to pre, ERPs adopters' enjoy better sales grow in post implementation period.

H6b: Adopters perform better in term of sales growth, in post ERPs implementation period, than that of their non-adopting matching firms.

Figure 4.1 is visualizing the conceptual framework of testing the impact of ERP status on selected dependent variables. This figure also shows the summary of hypotheses developed in this study. After an extensive review of studies on business value of IT by (Melville et al., 2004) developed an IT business value model. According to this model the IT business value can be determined by three main factors:

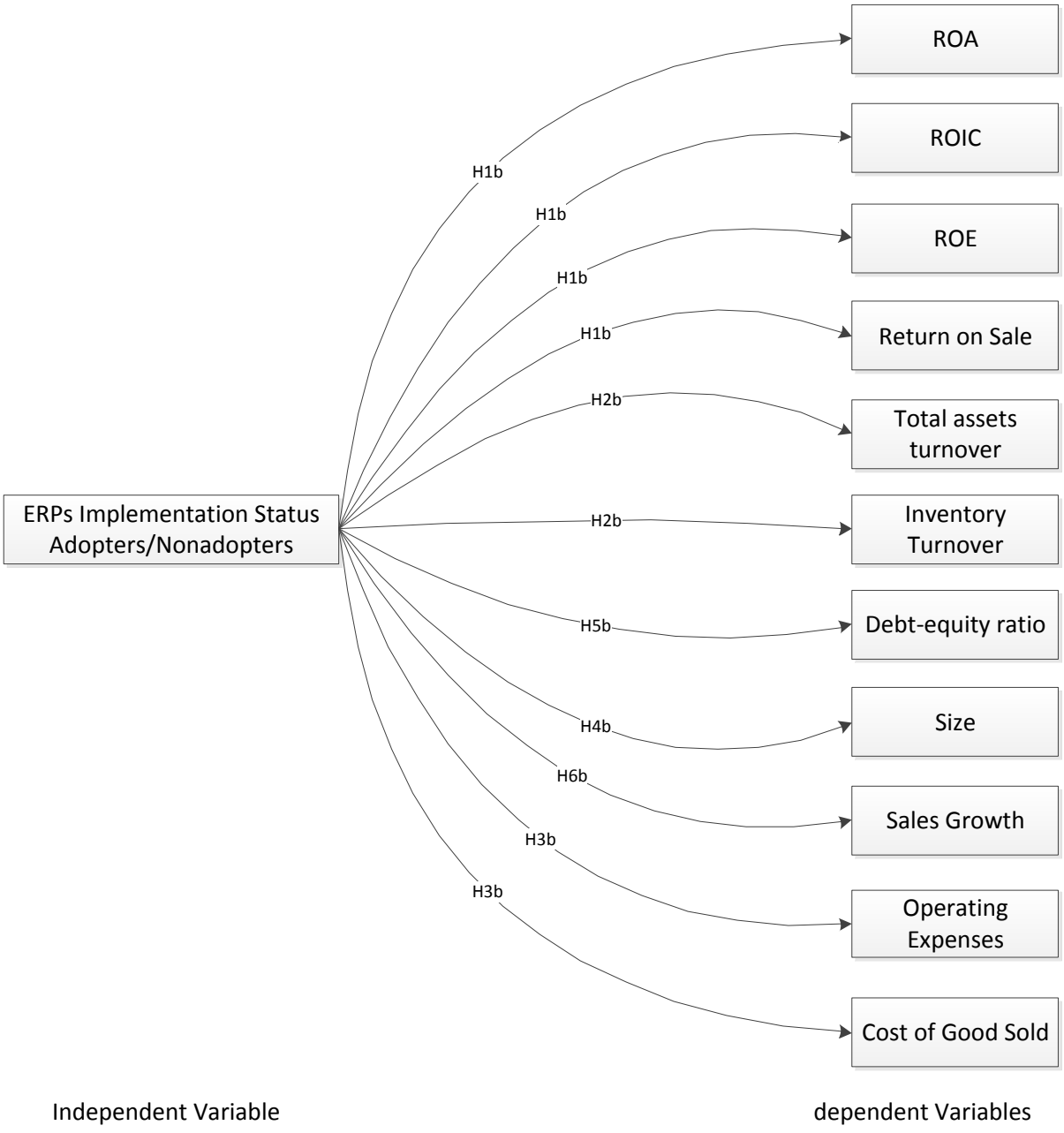


Figure 4.1: Conceptual framework for determining the pre to post ERP implementation effect

a) The extent to which IT resources enables certain business processes of focal firm to achieve desired performance

b) The reaction by competitors in the same industry and trading partners can have good impact on the focal firm's expected performance.

c) The impact of macro-economic environment within a particular country

As mentioned in chapter 3, we cannot see the focal firm in isolation. This could have been possible if there is monopoly of focal firm and there is no any close competitors of that firm in the market. This

form of competition is difficult to find except in special cases such as because of government intervention and in the condition of patent for a particular period. We have taken into account all these three IT business value determinants identified by (Melville et al., 2004). Points a and b are extensively discussed in chapter 3 in which we have proposed a model to evaluate ERP and c has been analyzed in chapter 1 in this study.

Resource based view, IT business value model by (Melville et al., 2004) can be compared with that of Figure 4.1 in this study which is showing the impact of ERP status on various variables of the study. We have controlled for a, b and c effect of model given by (Melville et al., 2004) at least at time one year before. This has further been discussed in detail in the methodology section of this study.

Table 4.1 shows the different variables which have been used in prior studies on performance effect of IS/ERP. We couldn't select all the variables mentioned in Table 4.1. Some of total variables we have selected, based on availability of data, such as ROA, ROE, ROS, TAT have been frequently used by different studies whereas other variables such as OX, Lev. COGS have rarely been used by a few studies as shown in Table 4.1.

4.5. Definition of variables

ROA is frequently cited as a measure of firm profitability by many studies as shown in table 4.2 however it has been calculated differently from one study to another. Aral et al. (2008) used pretax income, whereas Hunton et al. (2003) calculated ROA as income before extraordinary items over average of beginning and ending total assets. Following (De Andres et al., 2012) we used operating income for measuring ROA in this study because financial expense such as interest is non-operating expense which can significantly distort overall firms' earnings if firms have too much borrowing or accrued interest etc. Although already calculated ROA in the SBP's FSA could be used, we believe operating income is a better surrogate of firms' earning from operation as compared to already published and other above mentioned items used by other studies for numerator of ROA. More specifically we calculated ROA as item D7 plus D6 divided by C4 in SBP's FSA. Nicolaou and Bhattacharya (2006) have also provided same definition for ROA but they call it operating return on assets.

Table 4.2

Definition of variables used by other research papers

The purpose of this table is to summarize the variable definition. The first column as denoted by letter V indicate the variables used in this study. Second column shows definition of the variable in this study and third column point out prior studies that have used similar variable to measure the financial performance of the firms.

Variables	Definition	Variable used in prior research
ROA	$Return\ on\ Assets = \frac{Operating\ income}{Total\ Assets}$	(Hunton et al., 2003) (de Andrés et al., 2012) (Aral et al., 2008; Masli et al., 2011)
ROS	$Return\ on\ Sale = \frac{Operating\ Income}{Sale}$	(Hunton et al., 2003) (de Andrés et al., 2012; Masli et al., 2011)
ROIC	$Return\ on\ invested\ capital = \frac{Operating\ Income}{Noncurrent\ Liabilities + equity}$	(Hunton et al., 2003) (de Andrés et al., 2012; Masli et al., 2011)
TAT	$Total\ Assets\ Turnover = \frac{Sales}{Total\ Assets}$	(Hunton et al., 2003) (Aral et al., 2008; de Andrés et al., 2012; Masli et al., 2011)
ROE	$\text{Return on Equity} = \frac{\text{Operating Income}}{\text{Total Equity}}$	(Hunton et al., 2003) (Aral et al., 2008; de Andrés et al., 2012)
Size	$Size = natural \log of\ total\ assets$	(Hunton et al., 2003) (de Andrés et al., 2012; Mithas et al., 2012) (Kalkan, Erdil, & Çetinkaya, 2011) (Ruiz-Mercader et al., 2006)
COGS	$Cost\ of\ Goods\ sold\ to\ sale = \frac{COGS}{Sales}$	(Aral et al., 2008; de Andrés et al., 2012; Kossaï & Piget, 2014)
ITO	$\text{Inventory turnover} = \frac{\text{COGS}}{\text{Inventory}}$	Hitt & Zhou 2014(Aral et al., 2008)
OX	$\text{Operating Expense to sale} = \frac{\text{Sale} - \text{COGS} - \text{Operating income}}{\text{Sale}}$	(Aral et al., 2008) (Mithas et al., 2012)
SG	$\text{Sales Growth} = \frac{\text{Sales}_t - \text{Sales}_{t-1}}{\text{Sales}_{t-1}}$	De Andres 2012
DER	$\text{Debt equity ratio} = \frac{\text{Total Liabilities}}{\text{Equity}}$	Ali, 2011

*(Kalkan et al., 2011)** used sales variable instead of just sales growth. EBIT= earnings before interest and tax, COGS = cost of goods sold, SG&A = Selling, general and administrative, LTD = Long Term Debt, TD = Total debt ratio and BVTA = book value of total assets.*

The purpose of including the return on invested capital (ROIC) in this study is to have a check on the robustness of results using ROA and it has been used by plenty of studies as a proxy for performance (Hunton, et al., 2003; De Andres, et al., 2012). Hunton et al. (2003), de Andres, Lorca, and Emilio Labra (2012) and Nicolaou and Bhattacharya (2006) measure return on investment differently. Hunton et al. (2003) and Nicolaou and Bhattacharya (2006) used Compustat definition of ROI without any change

whereas de Andres, Lorca, and Emilio Labra (2012) take net income as the numerator over average stockholders' equity. ROIC is equal to operating income (D7 plus D6) divided by total capital employed, which is the sum of non-current liabilities and shareholders' equity, (A8 = A3+A7) in this study[4]. Although current liabilities are constant and changing over time but this may not be treated as capital employed because of its short life and huge fluctuations which can be observed after any big trade transaction. The word capital itself represents the long-term placement of anything. Ross, Westerfield, and Jordan (2008) argue that the analysts focus more on long-term debt instead of short term liabilities because current liabilities will constantly be changing thus they can represent the trade practices more than debt management policies. We have used two more frequently cited variables for the profitability of the firm in many studies are a return on equity (ROE) and (ROS). ROE is pretty different from that of ROA and ROIC because it represents the owners' interest. ROE measures value generated from firm's operations on each dollar invested in equity as operating income (D7 plus D6) over total share outstanding (A3) unlike OI over total assets and total capitalization of the firm in ROA and ROIC respectively. Whereas ROS measures the efficiency with which firm is generating a return on each dollar of revenue (as D6 plus D7 divided by D1). Although financial performances variable are interdependent, they reflect the different determinants of success or failure of a firm (Kinney & Wempe, 2002; Maiga, Nilsson, & Jacobs, 2013). Atkinson, Banker, Kaplan, and Young (2001) take ROS into account as a measure of efficiency gain from the ability to control cost at given level of sales activity.

In order to intensively analyze the major source(s) of expected return from ERP implementation in the form of ROA, ROIC, ROE, and ROS, we selected seven other dependent variables less frequently cited by other studies. Anderson et al. 2011 used ROS, selling general and administrative expense, and cost of goods sold for determining if the ERP could contribute ROA through strategic performance or operational benefit. For representing the operational performance they chose assets turnover, account

[4] ROIC is equal to F7+F6 divided by D+E in SBP's FSA latest two volumes included in this study. Likewise other variables in this study have different number in SBP's FSA latest two versions as compared to those of presented in text above because above mentioned items are belonging to SBP's FSA earlier pair of volume thus the reader should be careful while dealing with different volume of SBP's FSA.

receivable turnover, inventory turnover, and plant asset turnover. They find improvement only in ROA through ROS in post-implementation period. Although they also find the improvement in inventory turnover during ERP implementation which cannot be associated to ERPs as they claim the operational benefit of accelerated ERPs because such improvement has been reported during the ERP implementation it indicates that ERPs is still at its implementation stage and not in the use of the firms to claim its impact on ITO.

4.6. Strategic and operational nature of ERP

(Schryen, 2013) argues that studies on IS performance effect support both strategic and operation relevance of IS empirically. The nature of ERP is both strategic and operational thus making evaluation difficult because the strategic system is more extrinsic in nature whereas the operational nature of ERP is more intrinsic. Making organization more flexible and responsive to customer needs and a dynamic environment can be the priority of the strategic system (Stefanou & Correspondence, 2001). Qrunfleh and Tarafdar (2013) call it agile strategy and its typical application portfolio include demand forecasting, product scheduling, market analysis and CRM applications. The evaluation of agile strategy has to be based on perceived competitive impact which is different from one based on cost (Clemons, 1991) or IS efficiency strategy (lean strategy) which focuses on cost reduction, creating high inventory turnover, minimizing waste etc.(Qrunfleh & Tarafdar, 2013). Kaplan cited by (Clemons, 1991) argues that financial techniques such as discounted cash flow are constantly misused when applied to assess the strategic IT decision due to difficulty in the quantifying value of strategic systems. Thus, ERP is both strategic and operational in nature hence evaluation should be made from different perspectives. As shown in figure 4.2 different variables have been selected to represent the operational and strategic performance of the sample firms. Operational cost and benefits of ERP are more easily identifiable and quantifiable than the strategic ones but that does not mean that the strategic costs and benefits must be excluded from analysis.

4.7. Relationship among dependent variables

Vendors and many researchers argue that ERPs boost the firm performance through improving the efficiency and profitability. ROA is considered as a major surrogate of the financial performance of any firm because it represents both efficiency and profitability (Skousen et al., 1998) thus ROA can be a useful performance indicator.

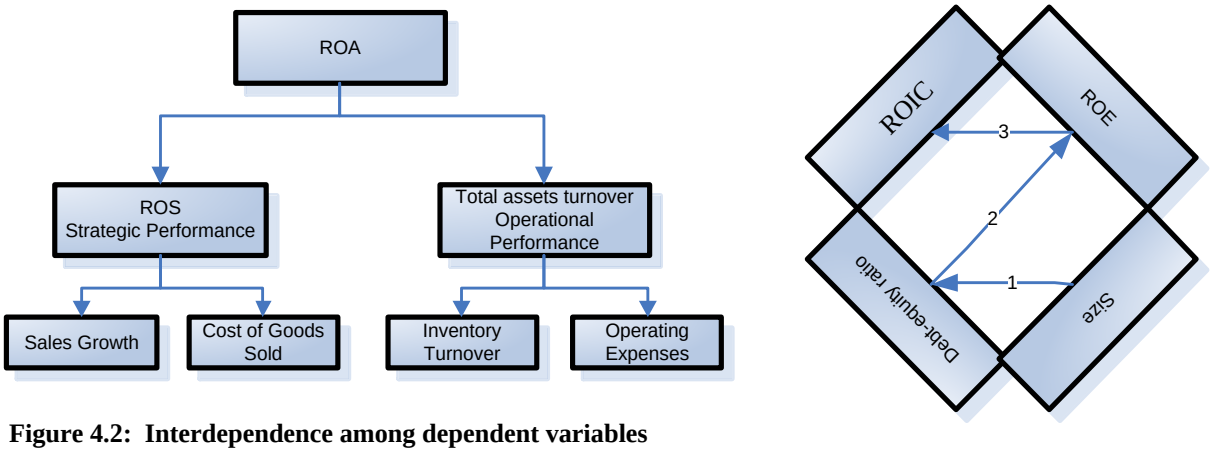


Figure 4.2: Interdependence among dependent variables

Efficiency and profitability embedded in ROA can be separated into ROS and TAT (Hunton et al.,2003) as shown in figure 4.2. On the one hand we include the sales growth and cost of goods sold to gauge if the improvement in ROS is triggered by an improvement in sales growth (item D1 in time t minus item D1 in time t-1 divided by item D1 in time t-1) and or diminution in COGS (D2 divided by D1). In order to test the impact of ERP implementation on total assets turnover of the firm we include inventory turnover and operating expense to see if the change in TAT (H7) is because of variation in ITO (B3 divide by C4) and or OX ((D1 minus D2 minus (D6 plus D7)) divided by D1).

The measurement of ROA can be tricky. The reduction (increase) in total assets with no change in the numerator will increase (decrease) the ROA results. The change in total assets represents the effect, but to determine if the effect is due to change in the denominator (total assets) of ROA we include size (natural log of D1). As Z inside the diamond in figure 4.2 shows size's direct and or indirect impacts, the larger size allow the firms to borrow more by pledging its assets as a security (Ali, 2011) hence significant change in size in post ERP implementation will directly affect the debt equity ratio of firm because positive relationship between size and debt-equity ratio has been empirically tested and

reported by many researchers (Ali, 2011) thus change in debt equity ratio can disturb the ROE. Hitt et al. (2002) study the impact of ERPs implementation on firms performance and interpreted significant negative coefficient for ROE as an effect of decrease in DER because they reported significant positive impact of ERPs implementation on ROA they argue that the negative coefficient for ROE is because of excessive rely on equity for financing the risky project such as ERPs before and during implementation. Total assets are financed by debt and equity (denominator of ROIC except short term liabilities) hence, in connection with size, it shows the indirect impact on ROIC of the firm.

Ross, Westerfield, and Jaffe (2010) measures ROE is equal to ROA multiplied by equity multiplier—one plus debt-equity ratio. This formula indicates that ROE and ROA are related to the debt-equity ratio of the firm. The debt-equity ratio has been used as a proxy of the capital structure of a firm. The purpose of including DER (G4) is to get some clue about the impact of ERP implementation on the capital structure of the firm. As ERPs are heralded as a tool to bring the efficiency and profitability for the adopting firm. Pecking order theory predicts that profitable firms give priority to an internal source of funding but if the internal source of finance is not sufficient then firm's second and third choices are debt and equity financing respectively. Trade-off theory of capital structure predicts that firms have a debt-equity target which firms determine by measuring the costs and benefits associated with debt are equal which theory says as the optimal capital structure of the firm.

Including debt equity ratio can provide the answer to two important questions. First, what is the impact of ERP implementation, as it is treated as a large investment, on the capital structure? More precisely how does ERP implementation affect debt equity ratio during implementation that can be measured as a change in debt-equity ratio from one year before to during? Second: Does ERPs implementation, as it brings efficiency which causes firms require less investment in total assets, affect the debt equity ratio in post-implementation periods?

The variables serve different purpose shown by the ratios. ROA, ROE, ROS and ROIC are profitability ratios to test the change in the performance after adopting ERP as compared to those of non-adopters. Two asset utilization ratios such as inventory turnover, total asset turnover are to test the efficiency of utilization of firm's asset after ERP adoption. One financial leverage ratio is selected to measure the

changes in the capital structure of the firm after during and after ERP adoption and what advantages and disadvantages can be brought by such change in capital structure. Two variables are used to test the operating performance of adopters and non-adopters. Last but not least two other ratios are used to check the impact of ERP on agency cost, and size of the firm.

Chapter 5

Data and Methodology

5.1. Objective of the chapter

The objective of this chapter is to enlighten the data, sources of data and type of data required to conduct this study. Methodology used to arrange the data into analyzable format is discussed next. Finally the regression model is developed and explained.

5.2. Data

The data for this study consist of a combination of qualitative and quantitative data. Qualitatitive data such as ERP, vendor, time of implementation, completion period etc. whereas quantitative data cover the financial data as explained in detail below.

5.2.1. Sample selection

We selected the sample of non-financial firms registered at the Karachi Stock Exchange (KSE) because KSE is the largest and most liquid exchange of Pakistan. The main reason to select KSE is the availability of financial data.

5.2.2. Primary Data

We developed a questionnaire that we sent to all non-financial companies listed on Karachi Stock Exchange. We could not include the financial institutions in this study because of unavailability of required financial data from 1999 to 2013. The purpose of making a questionnaire was to find out which companies implemented ERP, the vendor of ERP system (ERPs) and the year in which ERPs went live. The response time of adopting firms and the non-adopting firms were almost the same. A few firms responded quickly (in the same week they were sent questionnaire through google one drive) but the majority of firms responded only after being contacted repeatedly through email reminders, phone calls, and personal contacts. Despite huge efforts made we could receive only 70 responses and 30 percent of respondent firms adopted an ERP system or ERP modules. So the response rate is less than 13% of overall 539 firms registered at Karachi stock exchange. The number of response was not sufficient in

order to serve our research purpose thus keeping in the view the target of including as many firms as possible into our sample, we decided to search for secondary sources of data. Beside this, we also decided to search for the genuineness of responses provided into secondary data.

*others supplier include Microsoft Dynamic GP, BAAN, FIS Sweden, not reported vendors and local suppliers etc.

5.2.3. Secondary Data

Once we came out of lengthy primary data collection process we started to search for secondary data. The purpose of searching the secondary is dual: non-financial data and financial data. Keeping in mind the insufficient responses mentioned in primary data, the different secondary sources such as business newspapers, customer success stories published by vendors, consulting firms provided ERP implementation and training service, milestone and audited annual reports of firms on the web were used as sources of identifying ERP adopting firms. Incomplete pieces of data have been found using sources mentioned above and then these pieces of data were joined together for completing the important part of this research.

Table 5.1

Market Share of ERP supplier among sample firms

This table depicts the major supplier of ERPs in Pakistan. the column on one indicate the specific supplier who implemented ERPs or module of ERPs in a particular sample firm whereas column two show the percentage of sample ERPs implementation have been done by a specific supplier in column one.

ERP supplier	%
SAP	35
Oracle	34
In-house	7
Others*	22

Numerous problems have been faced while completing the data. Trusting one source or another for data have been practice in research but searching for data from its root is a difficult, time-consuming but unique experience. Collecting the data from its original document made us confident about its originality.

- **Non-Financial secondary data**

As consistent with many studies conducted internationally, SAP dominated the market however the difference of market share between SAP and Oracle is much lower in our sample than that of studies conducted in Europe and America. This is probablybecause Oracle, unlike other studies, has almost equal market share in the sample of Pakistani ERP adopting firms, but the decreased gap between SAP and Oracle in this study can also be because of unavailability of data for vendors for some ERPs adopters. As table 5.1 shows, SAP and Oracle capture 35 and 34 percent market share respectively. Madapusi and D'Souza (2012) report SAP as a market leader with 29.6 percent market share as compared to that of Oracle's 10.3 percent. SAP has a leading position with 39.58 percent followed by oracle's 16.67 percent in Spain (de Andres et al., 2012).

Table 5.2
Secondary sources and missing data

The first column in this table shows the specific sources from where partial data have been collected in order to complete the data column two, three and four show availability of different incomplete chunks of data. Last column shows extent to which each of data source in this table could contribute in total sample of ERP adopters.

Sources of data	Adopting firm	Year ERP go live	Vendor	N
Business Newspapers	√	X	√*/X	2
Customer Success Story Published by vendors	√	X	√	6
Consulting firm go-live announcement	√	√*	√	21
Audited annual Reports	√	√ /X	√ /X	27
Milestone (company)	√	√	√	09

√ Available data, √ available but checked for authenticity and X is missing data*

As mentioned in table 5.2 we faced many problems. First, the announcement by ERP implementation didn't provide the data for year and vendor in some cases. Second, customer success stories didn't provide the data for the ERP go-live year. Third, the announcement of go live by consulting firms provided a complete data set for a particular company, but we had to check the genuineness in annual reports of firms through the procedure given below. Fourthly, some companies didn't provide the information about a vendor from whom they bought and implemented an ERP system and they are the part of others in table 5.2. Finally, the number of companies which provide the data in milestone tab on

their respective website is very limited. Therefore, for any missing data, we used an alternative source of data to complete a data set of a particular company. T this practice of combining the pieces of information has enormously contributed in increasing the overall number of adopters in sample ERP implementing firms as mentioned by "N" in table 5.2. Audited financial statements of the company are a major contributor which helped us to find 27 of adopters.

In the case of mhe missing data for the year in which ERP go-live, for example, we take the following steps:

Step 1: we access the website of the firms and try to search a milestone tab on the website of the company.

Step 2. If we find the milestone tab on the firm's website, we try to collect the required data but if there is no milestone tab on the website of the firm or the required data is not available on milestone tab then we search for tabs such as investor relationship, investor information, financial or financial reports. The purpose of searching for these tabs on the website of a particular firm is to access the annual reports of the firms and to download them.

Step 3. After finding the annual reports of firms for which there is incomplete data, we download and open all the annual reports of such firms. The downloaded audited annual reports of a firm are in a different format such as pdf file, image file and a typically formatted file that opens in pdf format but the text of file can't be copied and/or converted into excel file. The purpose of downloading all annual report is to search the missing non-financial data such a year of ERP implementation. Audited annual reports in a typically formatted file for some companies with missing data make it difficult to search. To resolve this issue we convert that typical file into image file first then we converted that image with a trial version of "Able2Extract Professional" software into MS Excel format.

Step 4. After opening a downloaded copy of all audited annual reports of each firm with missing data, we use "Ctrl F" shortcut key for searching for words such as ERP, SAP, Oracle, Microsoft, computer software, intangible assets, and amortization if we still can't find any clue then we switched to another annual report of company. If the annual report is an image file then first we try to switch on the next

year report because it already includes the past year data for comparison purpose. If the annual report for next year is also an image file then we focus only on three areas of annual reports. They are director's report, financial statements such as balance sheet and statement of cash flows and notes to financial accounts. If we can't find any clue in these areas then we move to another financial report of firms with missing data.

Step 5. If we find that the firm is using ERP then we adopt the following procedure to identify the year in which ERP go-live. First of all, we use amortization statement for intangible assets to find the year in which firm starts to charge very first amortization expense for ERP. If we are lucky enough to find the very first amortization expense for ERPs in the first annual report then we fill in missing data for the year. But if we find that a particular firm has already a huge amount of amortization expense for ERPs then we start to search past annual reports until we find the very first amortization expense for ERPs that firms charged. We did all mentioned above in the guidance of table 5.2.

As table 5.3 shows year wise ERPs implementation, more than 70 percent of sample firms have implemented ERPs in between 2006 to 2011. So we decided to go through "Financial Statements Analysis of Companies (non-financial) listed at Karachi stock exchange (2006-2011)" published by State Bank of Pakistan in general and intangible asset item for each company in particular for identifying the firms with intangible asset. This made it easy for us to check the ERP implementation data for the only the firms having intangible assets because ERPs are regarded as intangible asset thus we could get the clue from that to search for if the firms have ERPs implementations experience.

Furthermore, for the years before 2006 and after 2011 we checked through annual reports of all non-financial firms to be sure if any company has invested before and after the period mentioned in State Bank's Publication. This time-consuming process ended at a significant increase in the number of ERP adopting firm in our sample. It is important to notice that the majority of sample firms implemented ERP from 2006 to 2011 with the highest percentage of sample adoption took place in 2010 as shown in table 5.3. This abundance of ERP adoption will be analyzed later in detail in order to know the reason behind such nimbleness in ERP implementation by Pakistani firms.

We categorize the performance measures into four groups. The relationship between them have been

Table 5.3

ERP implementation year (% of sample)

This table shows year wise implementation of ERPs where column one shows year in which ERPs implementation as percentage of total sample (in column two) took place.

Year	%
2002	3.9
2003	1.3
2004	0
2005	6.49
2006	10.39
2007	11.69
2008	9.09
2009	14.29
2010	15.58
2011	12.99
2012	9.09
2013	3.9
2014	1.3

Note: searching for ERPs implementation data for a year after 2011 is beyond the scope of this study because of unavailability of data, therefore, we didn't put serious effort for searching the ERPs data for the years 2012, 2013 and 2014. The number of ERPs implementation in 2012, 2013 and 2014 we have reported are representing the data we got accidently while searching for ERPs implementation data before that period thus the number ERPs implementation in these three years can be much greater.

discussed in the above:

Profitability measures: we finalized four measures already used by many studies are return on assets (ROA), return on invested capital (ROIC), return on equity (ROE) and return on sale (ROS).

1. Operational measures include total assets turnover (TAT), inventory turnover (IT), and operating expense (OX).
2. Strategic measures consist of sales growth (SG) and cost of goods sold (COGS)
3. Other measures: debt equity ratio (DER), Size.

- **Financial secondary data**

Financial data is the largest and the least time consuming part of this study. Initially the major sources of collecting this data were DataStream database and "Financial Statement Analysis of Companies (Non-Financial) Listed at Karachi Stock Exchange" publications—SBP's FSA from after here.

Later on we decided to rely only on different volumes of SBP's FSA because the data on DataStream and Compustat databases for Pakistani firms registered on KSE was missing for significant number of

firms and years. Although we had a missing data problem in SBP's FSA for years, the missing data problem in SPB'FSA was not as strong as it had been in data available at DataStream and Compustat.

- **Quality of financial secondary data**

Because the source of financial secondary data we have used in this study was not directly collected from well-recognized databases, the quality of data has been tested. For testing the quality of data used in this study we checked the authenticity of data through analyzing the publisher and sources of data collection for publishers. The different volumes of a specific document, that is a source of financial data in this study, have been published by State Bank of Pakistan which is a central bank of the country. More specifically Statistics and Data Warehouse Department of SBP is responsible for collecting data, checking its authenticity and furnishing data to the government, policymakers, academia and another stakeholder for making economic policies, support research and effective country wide decision making. The source of data published in SBP's FSA volumes has not been provided in the volume however the source can be audited annual financial reports published by companies or Karachi Stock Exchange—which has been the largest since (from the perspective of the stock traded and number of firm registered) and the most liquid (which has got the accolade of the best performing stock exchange in world in 2002 by Business Week and US Today (Ali, 2011)) stock exchange of Pakistan which is recently known as Pakistan Stock Exchange. Beside reputation of SBP as a publisher we double checked the data for that we randomly selected a few companies[5] and downloaded their audited financial statements for a randomly selected year such as 2012, 2013 etc. and matched the figure of particular items such as total asset, sales etc. and concluded the robustness of data through confirming that the data published in SBP's FSA has been taken from audited financial statements of firms. This exercise can be revised by any reader because the data is publicly available and anyone can access the financial data of SBP's publication and audited financial statements of firms registered on Karachi Stock Exchange.

[5] The name of companies can't be used in this study because the firms were provided guarantee to not use their name in this study.

5.3. Software, online web apps, and databases

The following software has been used in this study for different purposes:

- Microsoft Office
- Microsoft Visio
- IBM SPSS statistics 22version
- Online Web Applications (google one drive, email etc.)
- Datastream, Compustat
- Endnote X7.5 version
- Able2Extract Professional

In this technologically advanced era, numerous software has been developed to help the researcher in writing, making tables, drawing diagrams, do the analysis of data etc. All this makes it easy for researchers to work more reliably and faster than before. Microsoft Word and Excel have been used to write and manage the data respectively. Tables have been developed in excel and then pasted in MS Word. It is easier to make a diagram in Microsoft Visio than MS Excel thus models/ figures in this study have been drawn in MS Visio.

Primary data has been collected through making a questionnaire which was made in google doc file that automatically generated a link. We made a cover letter which includes the google doc link to access the questionnaire and sent it to the firms by email. There was a dual purpose of making a cover letter on the letterhead paper of Tilburg University. First, to take potential respondents into confidence about the genuineness of guarantee to not share the secret data or disclose the name of the firm in this thesis and second to ensure the researchers belongingness to an institution. It was expected that it would increase the chances of more submission of the filled questionnaires by sample firms. The email addresses of possible respondents were taken from KSE and firms official websites. By clicking google doc link in the cover letter the respondent can directly access the questionnaire page which contains different format of close-ended questions along with a submitting button that allows the respondent firms to

submit its response. Google doc then automatically makes a separate file in spreadsheet format to record the responses which can easily be copied and paste in excel etc.

Although we initially accessed the Datastream and Compustat to collect the secondary data for Pakistan non-financial firms these two databases couldn't match the expectation of this study. In particular, as compared to SBP's FSA, as mentioned above, the data was missing for many sample firms and years from 1998 to 2013 thus SBP's FSA was final choice of this study for collecting secondary financial data. The collected primary and secondary data were managed in MS Excel. As mentioned above, for searching the non-financial secondary data we downloaded the financial reports of the sample firms which were mostly in PDF format and for converting those financial reports of firms from PDF to excel file we use Able2Extract Professional trial version. The managed data then copies from excel to SPSS worksheet to run the analysis. All the figures included in this study were drawn in MS VISIO 2010. Then specific results were selected to report in the tables. These tables which contain results in its final shape were copied and pasted into MS Word from MS Excel.

5.4. Data analysis

Originally, 86 firms were found with ERP adoption through different sources. The advantage of utilizing multiple sources to identify the ERPs adopting firms is to identify and include those ERPs adopting firms into sample which have not announced ERPs implementation though newspapers, magazines or through any other media. The number of sample adopting firm reduced as mentioned in descriptive statistics because of two main issue, first, missing financial data on SBP's FSA, and second is the firms values may be identified and excluded as outliers by Mahalanobis' distance and or Cook's distance. The identified ERPs adopters become part of the sample in this study if the financial data is available for at least one year of each of three years before and after ERPs adoption periods. The matching non-adopters were identified though ROA, industry according to SBP's FSA and size of firms.

After excluding firms with missing financial data on SBP's FSA or as result of Mahalanobis' distance and Cook's distance, the number for firms in the sample was as high as 74 and as low as 36 for any variable selected in this study. The distribution of ERPs implementation is not clustered around a

particular industry, as shown in Table 5.4, however, the chemical sector is leading with 18 ERPs adopters followed by textile sector with 14 adopters. All firms in this study didn't announce ERPs completion time, which was estimated following estimation practice in prior studies.

Table 5.4
Distribution of ERPs implementation by SBP's FSA industry classification

The purpose of this table is to analyze how is ERPs adopted by different sectors in the sample of this study. Column one shows the serial number whereas column two indicates the industry/sector of adopters. The industry classification reported here has been done by SBP according to certain operations performed by a firm to produce a particular product. The number of firms, belonging to certain industry, that have implemented ERPs is mentioned in last column of this table.

S.No.	industry	No. of Firms
1	Textile sector	14
2	Chemicals sector	18
3	Engineering sector	11
4	Sugar sector	4
5	Paper and board sector	4
6	Cement sector	7
7	Fuel and energy sector	9
8	Transport and communications sector	3
9	Tobacco sector	2
10	Jute sector	1
11	Miscellaneous Sector	13
	Total	86

As shown in Table 5.5 descriptive statistics, the skewness and kurtosis z scores are given which indicate the normality of data distribution separately for adopters and non-adopters and histograms are given in Appendix A for pooled data pointing normality of data distribution. The descriptive statistics for performance variables are shown in Table 5.5. This table shows the mean, standard deviation, skewness z value, kurtosis z value and number of firms in year, prior to ERPs implementation (one year before) and average during, and one, two and three years after implementation for adopters and non-adopters (Post). As expected the average ROA for adopters and non-adopters in one year before ERPs purchase decision is almost the same. The average ROA for adopters is better by 0.003 than that of non-adopters.

As shown in Table 5.5 the adopters perform better in terms of return on invested capital, return on equity, total assets turnover, whereas non-adopters perform better in terms of return on sale, inventory

Table 5.5
Descriptive Statistics

This table summarize the descriptive statistics for adopters and non-adopters after excluding outliers through Mahalanobis Distance and Cook's Distance. Letter V in column 1 is for variables that have been selected in this study. Column 2 shows parameters that have been reported are mean, standard deviation (StD.), Skewness *z* value, kurtosis *z* value and number of observations (N). The values of these pre-determined parameters for each variable have been reported separately for adopters and non-adopters which provide vivid picture of performance trend for adopters and non-adopters from pre-to-post ERPs implementation periods. Five columns for ERPs adopters and ERPs non-adopters shows parameters' values for particular variables in time one year before (1YB), average during (Avg.D), one year after (1YA), two years after (2YA) and three years after (3YA) respectively. Asterisk for *z* value for Skewness and Kurtosis are calculated and reported using log10 transformation of variables.

		ERP Adopters					*ERP Non-adopters*				
V	*Parameter*	*1YB*	*Avg.D*	*1YA*	*2YA*	*3YA*	*1YB*	*Avg.D*	*1YA*	*2YA*	*3YA*
ROA	*Mean*	.116	.114	.125	.124	.139	.113	.088	.073	.058	.070
	StD.	.076	.074	.104	.075	.083	.079	.074	.078	.096	.070
	Skewness Z	1.588*	1.891*	2.478*	1.411	2.167*	1.463*	2.034*	2.001*	4.666*	1.404
	Kurtosis Z	0.066	-0.758	.905*	0.340	1.439	0.127	0.433	0.373	9.815*	0.217
	N	63	63	61	58	46	67	67	64	60	48
ROIC	*Mean*	.265	.230	.248	.243	.265	.208	.144	.123	.106	.096
	StD.	.185	.170	.214	.167	.184	.144	.127	.142	.167	.132
	Skewness Z	1.252*	1.774*	0.958*	1.870*	3.327*	1.969*	-0.783*	1.763*	-1.776*	-2.170*
	Kurtosis Z	-1.283*	-0.392*	0.786*	0.086*	1.700*	-0.627*	0.825*	3.536*	3.220*	2.242*
	N	74	74	71	67	54	69	69	67	63	50
ROE	*Mean*	.320	.289	.309	.314	.335	.275	.188	.160	.131	.137
	StD.	.197	.188	.251	.183	.190	.173	.149	.182	.254	.173
	Skewness Z	-0.694*	-0.382*	-1.247*	-1.489*	1.687*	2.162	-0.753	0.447	-5.839	-1.310
	Kurtosis Z	-0.084*	0.931*	2.706*	1.526*	0.200*	-0.170	-0.430	3.043	10.922	2.498
	N	73	73	70	66	53	67	67	65	61	48
ROS	*Mean*	.113	.101	.100	.106	.114	.121	.089	.064	.052	.061
	StD.	.067	.058	.087	.063	.067	.077	.078	.073	.110	.102
	Skewness Z	1.573*	1.029*	-2.570	0.762*	2.440*	3.210*	0.115*	0.238	-2.980	-1.348
	Kurtosis Z	-0.798*	-1.465*	5.039	1.399*	0.317*	1.321*	0.325*	0.712	4.170	7.362
	N	68	68	65	62	49	66	66	65	61	46

Continue Table 5.5 Descriptive Statistics

		ERP Adopters					*ERP Non-adopters*				
V	*Parameter*	*1YB*	*Avg.D*	*1YA*	*2YA*	*3YA*	*1YB*	*Avg.D*	*1YA*	*2YA*	*3YA*
TAT	*Mean*	1.256	1.227	1.255	1.307	1.341	1.002	.966	.943	.931	.949
	StD.	.724	.656	.693	.695	.602	.552	.636	.597	.618	.730
	Skewness Z	0.373*	0.779*	1.440*	0.249*	0.512*	0.740*	-0.071*	1.033*	1.630*	0.902*
	Kurtosis Z	-1.188*	-0.559*	-0.226*	0.053*	-1.019*	-0.866*	-1.602*	-0.182*	0.309*	-0.972*
	N	71	71	68	64	51	70	70	67	63	49
ITO	*Mean*	6.074	6.457	6.241	6.337	7.365	6.819	6.640	6.600	8.276	8.594
	StD.	4.559	4.569	4.342	4.775	7.023	6.230	5.688	5.959	9.903	9.758
	Skewness Z	-0.168*	2.444*	1.739*	2.182*	2.556*	2.100*	1.442*	1.939*	2.417*	2.797*
	Kurtosis Z	0.970*	-0.073*	-0.403*	0.572*	1.349*	1.252*	-0.498*	0.442*	1.258*	1.556*
	N	55	55	52	49	37	56	56	52	48	34
DER	*Mean*	1.535	1.531	1.688	1.627	1.494	1.337	1.407	1.536	1.639	1.552
	StD.	.948	1.005	1.408	1.257	1.264	1.028	.958	1.126	1.306	1.318
	Skewness Z	-0.102*	0.309*	1.540*	1.327*	2.188*	0.783	0.015	0.560	0.906	0.994
	Kurtosis Z	-1.524*	-1.671*	-1.049*	-0.423*	1.275*	-1.957	-1.378	-1.269	-0.497	-0.232
	N	71	71	68	65	52	65	65	61	54	45
SZ	*Mean*	8.438	8.640	8.838	8.934	8.956	7.375	7.634	7.891	7.884	8.030
	StD.	1.331	1.273	1.302	1.301	1.305	1.330	1.385	1.371	1.467	1.392
	Skewness Z	0.700	0.695	0.547	0.063	0.456	0.860	0.200	-0.481	-0.577	-0.499
	Kurtosis Z	-1.221	-0.938	-1.020	-0.741	-0.181	-0.379	-0.462	0.162	-0.400	-0.342
	N	71	71	70	65	53	70	70	69	64	51

** The Skewness and Kurtosis value calculated using log10 of variables*

Continue Table 5.5 Descriptive Statistics

		ERP Adopters					*ERP Non-adopters*				
V	*Parameter*	*1YB*	*Avg.D*	*1YA*	*2YA*	*3YA*	*1YB*	*Avg.D*	*1YA*	*2YA*	*3YA*
SG	*Mean*	.574	2.763	4.538	3.148	4.303	.769	1.514	2.087	2.784	1.267
	StD.	7.166	6.132	16.589	9.552	10.909	6.526	4.931	13.934	15.776	7.706
	Skewness Z	0.870	5.602*	6.698*	7.274*	4.927*	5.582*	6.297*	7.345*	2.100*	6.466*
	Kurtosis Z	13.090	2.472*	6.131*	7.737*	2.900*	5.616*	5.685*	12.161*	11.546*	10.172*
	N	55	55	49	47	36	55	55	48	46	34
OX	*Mean*	.070	.075	.068	.072	.072	.044	.052	.054	.063	.053
	StD.	.061	.067	.074	.074	.084	.057	.044	.065	.053	.051
	Skewness Z	2.979*	4.082*	2.294*	3.503*	1.785*	-0.210*	3.467*	-1.422*	4.739*	3.804*
	Kurtosis Z	0.181*	1.185*	0.666*	0.691*	0.660*	3.590*	3.052*	14.470*	3.206*	2.723*
	N	68	68	65	62	49	69	69	66	62	47
COGS	*Mean*	.816	.815	.826	.814	.807	.823	.844	.867	.878	.880
	StD.	.095	.091	.107	.111	.110	.097	.094	.089	.100	.118
	Skewness Z	-1.096	-2.997	-1.767	-4.593	-3.582	-2.891	-2.141	-1.132	-0.709	-2.487
	Kurtosis Z	-0.688	1.390	1.776	7.352	3.029	0.838	1.201	1.908	0.350	5.154
	N	68	68	67	62	51	69	69	66	61	48

** The Skewness and Kurtosis value calculated using log10 transformation of variables*

turnover, sales growth and operating expenses in time one year before ERPs adoption. The adopters have larger size, debt equity ratio than that of non-adopters in time one year before ERPs implementation. In depth analysis of post ERPs implementation in Table 5.5 descriptive statistics, reveals a little improvement and a large decline in overall performance of adopters and non-adopters respectively. The hawk eye on performance pattern of ERPs adopters only in Table 5.5 points out the decline in performance for most of the variables during implementation period. De Andres et, al. (de Andres, Lorca, & Labra) argue that the effect of ERPs will start only after implementation period, therefore a large decline in average performance of non-adopter in average during implementation time period in Table 5.5 can confuse the reader about the effect. Thus it is worth to note that average during performance is the average of estimated one year period during implementation and one year after implementation periods—which we called ERPs orientation period in order to address some problems mentioned in prior section. This discloses the ERPs immediate effect, in orientation period in term of decline in performance of non-adopters such as in ROA, ROIC, ROE etc. The number of firms varies from time to time because of missing financial data in SBP's FSA, or due to exclusion of outliers from descriptive statistics. Z value for Skewness and Kurtosis with asterisk show that values has been reported in Table 5.5 are generated after using log transformation of variables.

5.5. Methodology

Numerous factors are involved that contribute to the success of an organization. Controlling for all variables that contribute to success is not possible therefore this study, following prior research (Balkrishnan et al.,1996; Barber & Lyon, 1996; Bharadwaj, 2000; Poston Grabseky, 2001, Hunton et al., 2003; Nicolaou, 2004; Etezady, 2008; Anderson et al.,2011, De Andre et al., 2012 (Dumitru, Albu, Albu, & Dumitru, 2013; Lunardi et al., 2014) used a control group in order to control for industry, economic and effect of time and management practices.

5.5.1. Criteria for matching adopters and non-adopters

For selecting non-adopting matching firms three tools such as ROA, industry and size, have been considered in prior research. Madapusi and D'Souza (2012) and (de Andres, Lorca, & Labra, 2012)

selected matching non-adopters based on size and industry. In this study, we selected matching non-adopters for each ERPs adopters in the sample. Although (Anderson et al., 2011) also used size to match non-adopter for each ERPs adopters, they argue that a coefficient of "1" for non-adopter performance, when regressed on adopters' performance measure, would provide a good starting point to measure the ERPs impact on performance difference in post-implementation period. Barber and Lyon (1996) indicate that selecting matched group based on prior accounting metrics performance is critical to get powerful test statistics. Hendricks et al. (2007) argue that without matching prior performance it will be unclear to conclude whether the observed abnormal performance is due to mean reversion or due to the event under consideration. Following (Barber & Lyon, 1996; Hendricks et al., 2007) and in the light of above arguments, the matched non-adopting group for the ERPs adopting sample in this study has been selected based on similar financial performance, industry and size one year before ERPs adoption.

ERPs adopting firm at the year preceding the ERP implementation year such as at time $t_i - 1$ shown in figure 5.1 and these tools help us to control for industry and size effect whereas no performance differential at time $t_i - 1$ provides a good starting point. In following way, we match ERP system adopters and non-adopters.

Step 1. For each sample ERPs adopter, we identify all the non-adopters in the same industry and size by using State Bank of Pakistan's industry classification. From all identified non-adopters we select those firms whose ROA is within the range of 90-110 percent in the year preceding the ERP implementation year. The range of 90-110 percent of performance generates well-identified test statistics (Barber & Lyon, 1996) .

Step 2. If we can't find any firm in the same industry then we attempt to filter within the range of 90-110 percent of ROA and approximately same size without taking care of industry.

Step 3. If we can't find any matching firm in step two, we chose non-adopters without considering the size and industry.

Step 4. If we still can't find any firm in step three we chose non-adopters with closest ROA without considering all factors in step three.

5.5.2. The problems and remedies in matching ERP adopters with non-adopters

The table 5.5 indicates the extent to we have been successful in matching adopters and non-adopters. This matching between adopters and non-adopters is perfect. As shown in table 5.6 the 100 percent pairs in all sectors have been matched exactly on the basis of similar ROA one year before ERP implementation. The logic behind matching in time one year before adoption is to control of any effect of ERP investment announcements by adopting firms. More than 80 percent of matching between adopters and non-adopters, which is within 90 to 110 percent range of ROA, has been achieved in five industries in Table 5.6.

Table 5.6
Matching between ERP adopters and non-adopters

This table indicates the extent to which the matching of adopters and non-adopters could be done. Column one show the name of sector. Column 2 shows the percentage of adopters in each sector could be matched with non-adopters in time one year before. Column 3 and 4 represent the percentage of adopters in particular sector that are matched within 90-110 and 75-125 range of ROA respectively. Percentage of adopters in a sector that are matched based on common industry is shown by column 5. Percentage of total number of adopters belong to specific sector which could be matched on the basis of two size ranges given in columns 6 and 7 respectively.

Sector	1YB%	ROA		industry	size	
		90-110%	75-125%		90-110%	75-125%
Textile	100	69	92	100	23	69
Jute	100	0	0	100	0	100
Sugar sector	100	100	100	75	75	100
Miscellaneous sector	100	80	90	70	20	40
Engineering sector	100	75	83	67	58	75
Cement sector	100	50	67	50	33	83
Fuel and energy sector	100	83	100	50	50	50
Paper and board	100	100	100	50	50	75
Transportation and com. sector	100	50	50	50	50	75
Chemical sector	100	63	81	44	50	75
Tobacco sector	100	100	100	0	0	0

The purpose of mentioning another range of 75 to 125 percent of ROA and ROE is to demonstrate that matching beyond range of 90 to 110 percent is not too far. We can observe a significant stability in matching between adopter and non-adopter when 75 to 125 percent range is considered. while switching from 90-110 to 75-125 range for ROA in Table 5.6, eight out of eleven sectors achieve more than 80 percent of match between adopters and non-adopter but it is still far from the optimal range of ROA such as 90-110 recommended in literature. In order to tackle the problem of not having perfect matching

between adopters and non-adopters in term of ROA one year before ERP implementation the Mahalanobis' Distance and Cook's distance has been applied in order to remove the outliers as mentioned in section 5.10.2 of this chapter. As mentioned by "N" in table descriptive statistics the number of ROA adopters and non-adopters has decline to 63 and 67 respectively from original 86 pairs of adopters and non-adopters. It has worth to note that regression analysis was performed on the same data as reported in descriptive statistics, this points out that the ROA for adopters and non-adopters was exactly the same for adopters and non-adopters with unstandardized coefficient of more than 0.96 along with adjusted R square of more than 92. This means the change in adopters' performance is determined more than 96 percent by non-adopters and this model explains more than 92 percent of change in dependent variable. These results can be interpreted as change in independent variable by 1 such as ROA for adopters will change the ROA for non-adopters by approximately 1. The exercise of regressing the ROA of non-adopter over Adopters brought the ROA matching range within the acceptable range of 90-110 percent.

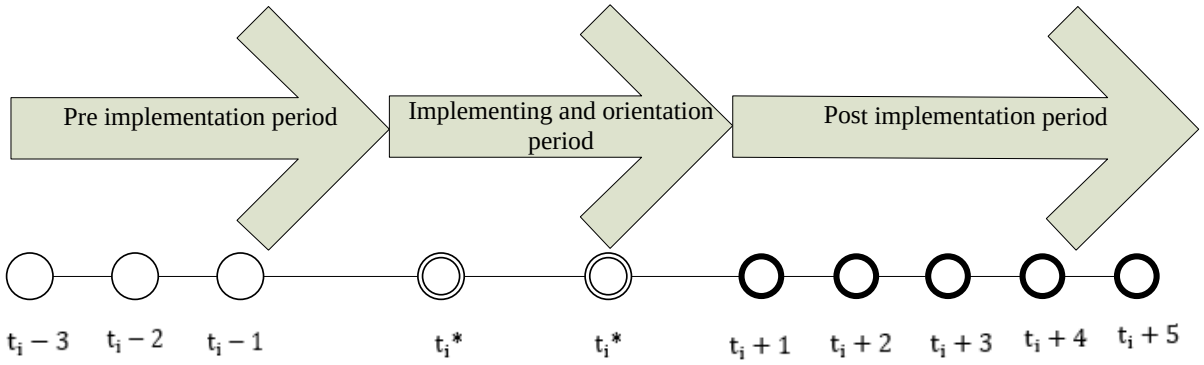
More than 65 percent of industry matching between adopter and non-adopters in five sectors can easily be observed in table 5.5. Additional four sectors have 50 percent of industry matching between adopters and non-adopters. The main reason of industry mismatch between adopters and non-adopter, for a particular sector such as chemical industry, is ERP adoption by the majority of firms in chemical industry with a gap of one or two years. Therefore it becomes difficult for us to match industry perfectly. Another reason of such an industry mismatch between adopters and non-adopters is considering other factors too such as ROA and size. This industry mismatch between adopters and non-adopters can question the results of this study. To tackle this issue, an industry dummy has been used by studies to control the industry effect (Melville et al., 2004). Despite the fact that we have achieved 50 or greater industry match between adopters and non-adopters in the majority of sectors as mentioned in table 5.5, this study, following the literature, uses industry dummy variables for controlling the effect of particular industry.

Size has been given least priority while matching ERP adopters with non-adopters. The size of 50 or percent of adopters and non-adopters in a particular sectors have been matched in six sectors in the

range of 90-110, but this percentage of matching base on size is increased in between 69 to 100 percent in eight sectors when 75-125 percent size range is considered. Although switching from one size range (90-110) to another (75-125) improved both percentage of matching of total firm in an industry as well as the number of sector in which such improve occur, we do not achieve the optimal level. (Mabert, Soni, & Venkataramanan, 2003) examine the impact of size on financial performance of ERP adopters and find that larger firm have improvement in financial measures whereas smaller firms performed better in manufacturing and logistics. To solve this critical issue the size has been used in the multiple regression equation along with all other dependent variable to test and control the effect of size on the results.

5.5.3. Post ERP implementation time selection

In this study, we compare the performance of ERPs adopting firms with those of comparable non-adopting firms based on criteria mentioned above. In this way, the ERPs adopting group and ERPs non-adopting group were made. The performance of adopters and non-adopter has been compared to find any impact of ERPs implementation on financial performance from pre (one year before) to the post-period (during, one year after, two years after and three years after).



t_i* *is time period equal to average of two years*

Figure 5.1: Pre, through and post ERP implementation period

Three, to five years depending upon availability/possibility of data for example if a firm has deployed ERP system in 2012 then we don't have the data to analyze in such a situation. Therefore, we make ending post-implementation years flexible. To be included in the sample of this study, the adopting firm

must have at least one year of post implementation performance irrespective of whether adopters have implemented a complete ERPs suite or ERPs modules. Etezady (2008) investigated the impact of ERPs scope on the financial performance of the adopting as compared to the non-adopting firms and couldn't find any support for better financial performance for those firms with larger ERPs scope. We couldn't include this research question because of unavailability of data.

5.5.4. Literature review for estimation of ERP implementation period

The data about ERPs implementation we have is pretty authentic because it has been collected directly from the audited financial statements of the firms. However, the data about the implementation period is missing for the majority of the firms, therefore, we decided to consider the literature to estimate the implementation period in prior studies. McAfee (1999) and (O'Leary, 2000) report that ERPs implementation takes 1 to 3 year period with an average of 21 months. Concluding a study consist of 43 respondent firms Stratman (2001) report a 17.1 months average period from starting the installation of ERP to go live. Mabert, Soni, and Venkataramanan (2000) conducted a survey among 479 manufacturing firms and report that US manufacturing firm take a 17.5 months weighted average time period for completing the ERP installation. More recently Nicolaou (2004) calculated mean time period of 7.78 months as reported by some firms as actual time while other mentioned only expected ERP implementation completion time of 9.92 months Consistent with (Nicolaou, 2004) reported period, Etezady (2008) report an average 9.68 months (as information provided by some firms) and 10.54 months (according to information provided by other firms) for actual and expected time period respectively. Both of the recent studies use one year period as implementation period. Consistent with more recent studies, in this study we estimate a one year ERPs implementation period because the majority of ERPs adopters in Pakistan implemented ERPs modules instead of the complete ERP suite which requires less time to complete implementation. However it is important to consider that ERPs implementation is in its initial stage unlike in developed world and it can easily be observed that prior studies reported more time to implement ERPs. Although it is recognized that learning from ERPs implementation has decreased the time to implement the ERPs, we believe that adopters in Pakistan would have faced similar difficulties as that of faced by adopters in the US in very early ERPs adoption

because more than 70 percent of adopting firms has implemented ERPs after 2006. Therefore, it is believed that average one-year period for implementation is suitable in Pakistan.

As far as the question of the time period required to capture the full impact of ERPs implementation on firm performance is concerned, the existing literature provide little guidance about the length of post-implementation time (Hendricks et al., 2007). However, there is unanimous agreement among researchers to take a longer period of time. Hunton et al. (2003), Hendricks et al. (2007), (Etezady, 2008), Mithas et al. (2012) and de Andres, Lorca, and Emilio Labra (2012) used three to five years for measuring the impact of ERPs on Firm performance. Following these studies, we take the same length of the post-implementation period such as 3 years.

In this study, we are not considering the year in which ERP systems go live for addressing two main issues. First, the time period in which the ERPs go live is different for each adopter, for example, some companies go live in the first quarter of financial year whereas ERPs at other firms go live in a second, third or fourth quarter of the financial year. It must be considered that the year in which ERPs go live can affect the result because the firms that deployed ERP system in the first quarter have around 9 months to use ERPs and firms that finished the processes of ERP deployment in a third or last quarter of the financial year would have around five to one month respectively to use ERPs. The purpose of start including the post-implementation period from very next year of ERPs go live is to ensure that the adopting firm is using ERPs at least for one year. Second, there is the difference in the financial reporting period of sample firms because some firms' financial years end on 30th June whereas other firms reporting periods end on 31st December. It means that the two adopters completing ERPs implementation in the same month would have a different period of ERPs use. As figure 5.1 shows, a one-year period for ERP system implementation together with the year of ERP system go live may be considered as the implementing and orientation period of ERPs as denoted by t*. However, for our regression model, the average during performance have been calculated and used.

5.6. Statistical Model

In this study, a two-staged analysis was carried out. Therefore following the literature we selected a pair of tests for doing pre-to-post ERP implementation analysis of adopters only at the first stage and a test

for analysis of relative pre-to-post performance differential between adopters and non-adopters at the second stage.

5.6.1. Selection of tests for pre-to-post analysis

For doing pre-to-post analysis, we focused only on adopters, as the aim of this analysis was to see if there is statistically significant variation in performance from one year before ERPs implementation to during (average), one, two and three years after implementation respectively. The results of this stage can generate the evidence for post-ERPs implementation gains/loss in term of financial performance for adopters. Literature well guided us in selection of tests for doing pre-to-post analysis. Literature offers both parametric and non-parametric tests subject of normality distribution assumption. The paired sample t-test is most suitable to use if the data is normally distributed and variance in the mean of a sample is tested in multiple periods thus we have performed paired sample t-test.

Although the normality of data distribution recommends to perform parametric test for analysis of data, the non-parametric test has also been run. The purpose of running non-parametric test was to address two main issues. The number of observations in descriptive statistics is reported after removing the outliers identified by Mahalanobis' Distance and Cook's Distance according to regression model, in this study, whereas mean value and number of observation as denoted by N in table 5.5 are different which can question the normality of data for performing t-test. Therefore, the non-parametric test has also been performed to validate the results found through parametric test. The parametric tests include Paired Sample T-Test for reporting pre-to-post ERPs impact on adopters' performance. As mentioned in prior sections, multiple criteria have been used to qualify the normality of data distribution. We have regarded the data as normally distributed if it has met any of three criteria mentioned in prior section. As this may leave some doubts in the mind of a reader, Wilcoxon paired rank test, a non-parametric test has also been performed to validate the robustness of results

5.6.2. Regression Analysis

At the second stage, the regression analysis has been conducted for every financial ratio for ERPs adopters and non-adopters. The suitability of multiple regression models in this study has been

examined. The normality distribution of data assumption of multiple regression has been reviewed through skewness and kurtosis which reveal no violation of this assumption in this study. Results of Pearson's correlation matrix among independent variable in this study indicated no multicollinearity problem. Durbin-Watson score in this study was also within normal range, this means, greater than one and less than 2.5 which indicates that residual are independent. The Mahalanobis' Distance and Cook's D were applied to remove any outlier in this study. The normal p-p plot shows all the residual cluster around the line for all variables in this study suggesting the assumption of normality has been met. We couldn't find any violation of multiple regression analysis assumptions. Finally, multiple regression was performed in SPSS to test if there is any ERPs implementation impact on post implementation financial performance of adopters and non-adopting counterparts. We apply the following statistical equation for testing our hypotheses for ERPs adopters and non-adopters.

$$A = \beta_0 + \beta_1 \text{PreERP} + \beta_2 \text{ Size} + \beta_3 \text{ ERPs Dummy} + \beta_4 \text{ Industry Dummy} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

A = average during and post ERP performance as measured by performance over time t_0 to t_{+3} for all the variables in table 4.2 whereas t_0 shows the average performance during implementation as this has been ignored by (Hunton et al., 2003). The advantage of including during ERP implementation is that is allows us to know the performance in this period and compare the performance in this period with that of reported by other studies. β_0 is constant whereas β_1 shows the coefficient for Pre-ERP adoption performance as measured by performance in time t_{-1} unlike other studies such as Hunton et al. (2003), Etezady (2008) used an average of performance over time t_{-3} to t_{-1} and t_{+1} to t_{+3} in before and after periods respectively however instead of average value, actual values have been used in this study which is more robust and reliable. Therefore performance in t_{-1} has been regressed over performance in time $t_0, t_{+1} t_{+2}$ and t_{+3} to compare the post-implementation impact of ERPs on the financial performance of adopters and non-adopters. β_2 indicates the coefficient for size. The objective of including the size in the regression model is to control the effect of size because the least number of sample firms could qualify this criteria during matching ERP adopters with non-adopters.β_3 represents the coefficient for ERP Dummy variable which is equal to 1 if the firm is an adopter and 0 if the firm is non-adopters and ε is error term. β_4 is the industry dummy to control for a particular industry effect

in determining the performance differential between adopters and non-adopters. Industry dummy is coded as 1 if adopters or matched non-adopters belonging to a particular industry and 0 otherwise. The positive or negative coefficient for β_1 denote the relationship between pre and dependent post implementation ratios. The most interesting and important part of regression model is the coefficient or value of β_3. Keeping in view the ERPs dummy variable coding, the positive value for β_2 will show that the ERPs adopting firms perform better than non-adopting competitors for a particular financial ratio under consideration and vice versa if the value for β_2 is negative. To be part of the sample in this study, a firm must have at least one value in time t_{-3} *to* t_{-1} and t_{+1} to t_{+3}.

5.6.3. Validation of statistical model

Although different models can be used by for measuring the impact of ERPs on performance differential between adopters and non-adopters in during and post implementation periods, many have used the above-mentioned model in their studies. Hunton et al. (2003) , Etezady (2008), (de Andres, Lorca, & Labra, 2012) etc. have relied on this model to analyze their sample data. All of them used regression analysis despite the fact that none of them could meet the normality assumption of regression analysis and used non-parametric Wilcoxon paired rank test as a primary test instead of t-test to analyze the pre-to-post performance of adopters. Frequent use of the above-mentioned equation by different researchers from time to time, indicates its reliability to extract the ERPs impact , so following Hunton et al. (2003) , Etezady (2008), (de Andres, Lorca, & Labra, 2012) etc. the said model has been selected for analysis.

5.7. Normality Distribution tests

A good number of tests have been designed to check the normality of sampled data among other frequently used test are Kolmogorov-Smirnov, Shapiro-Wilks tests, Skewness and Kurtosis etc. It is important to run these tests for deciding whether to apply the parametric or non-parametric test for the analysis of sample data. Many statistical packages, such as SPSS, Eview, Stata, Matlab etc., offer these test. In this study, we used the IBM SPSS Statistics 22 version for analysis. SPSS recommends the Kolmogorov-Smirnov and Shapiro-Wilks tests if the sample size is less than 50 (Elliott & Woodward, 2006). In this study the number of observations in sample dataset is greater than 50 thus we use

Skewness and Kurtosis tests instead of Kolmogorov-Smirnov and Shapiro-Wilk's tests for checking the normality distribution of sample data.

Skewness is a measure of the symmetry of sample data. Similar tails on the left and right sides of central point indicate the normality distribution of a data set. A data set can have a longer tail on the left or right side. This shows if the data set is negatively or positively skewed. A negative skewness shows longer tail on the left side whereas longer tail on the right depicts positively skewed data.

Kurtosis is a measure of tailedness of normality distribution of a real-valued random variable, however, the Kurtosis number does not measure the peakedness (Westfall, 2014). The Kurtosis can be of three types: Leptokurtic, Mesokurtic, and Platykurtic which measure the degree to which outliers can persist with sample data being used. The higher the Kurtosis value (K-value), usually greater than three, the higher the chances of outliers' persistence in the sample data and vice versa. Leptokurtic occurs when the shape of the distribution is taller than normal or bell shape curve distribution. It doesn't mean lower K-value is highly acceptable because it indicates lower chances of outliers' existence in the sample data. The mesokurtic curve is also called the normally distributed curve and any curve shape flatter than normal distribution is called Platykurtic.

Different acceptable values for Skewness and Kurtosis have been reported in the literature. Some researchers believe that K-value equal to three shows a normal distribution of data and any deviation such as positive or negative from three will bring positive (Leptokurtic) and negative (Platykurtic) kurtosis respectively. Some argue that Skewness and kurtosis statistics below the one can be treated as rule of thumb however others researchers recommends, the sample is considered as normally distributed if the z value of Skewness and Kurtosis results are between ±3.29 which can be measured by dividing the skewness and kurtosis value by its respective standard error (Elliott & Woodward, 2006) or in other words, the skewness and kurtosis value must be less than twice of their respective standard error. Although we calculated and reported z value for Skewness and Kurtosis, we have taken into account all of the above mentioned criteria. First, we give preference to z value and our second choice is transformed z value and finally, we use ±1 absolute statistics for skewness and kurtosis. To handle

positive or negative skewness we used a log transformation of some variables if necessary as shown by an asterisk in descriptive statistics. The literature recommends transformation of data for handling the skewed data. The skewness can be positive or negative and the process of transformation of data can be different for negative and positive skewness if it is beyond the acceptable level. Commonly, log transformation has been used to transform the data, but, the square root transformation can also be used to transform the data.

For handling the positively skewed data beyond the acceptable criteria as mentioned above, a simple process has been used. If there is no negative and zero value in sample variable to be transformed by applying either square root or log transformation directly by selecting transform and compute variable tabs in SPSS then we open compute variable, a dialog box will appear. Next, you will have to input the name of the transformed variable and numeric expression will look like "Log 10 (variable name)". If there is any zero value then numeric expression will look as "Log 10 (variable name +1) and numerical expression will appear as "Log 10 (variable name + (positive value if added to the largest negative value must provide result of plus one)" if there is a negative value within the variable that is being transformed. For example, if the largest negative value is equal to -3 then the value to be added is 4. For dealing the negative skewness, for transforming into log we need to put following in numerical expression as "Log 10 (maximum number for the variable + 1 – variable name)". West, Finch, and Curran (1995) argue that skewness and kurtosis are related to sample size, therefore, the critical value to reject null hypothesis need to be different according to sample size. They recommended the following three z-values to accept normality distribution of sample size.

- Small sample size ($n < 50$): α level 0.05 is achieved at 1.96 z value for skewness and kurtosis if the observations in the sample are less than 50. The non-normal distribution of the sample can be assumed if the z-score for either skewness or kurtosis is larger than 1.96.
- Medium sample size ($50 < n < 300$): for the sample size greater than 50 and less than 300, if the absolute z-score for either skewness or kurtosis is larger than 3.29 which corresponds to α level of 0.05, then the distribution of sample can be assumed non-normal.

- Large sample size (n > 300): for the sample size greater than 300, the normality distribution depends on histograms and absolute skewness and kurtosis rather than z-score. Absolute skewness value greater than 2 and absolute kurtosis (proper) larger than 7 may be treated as a reference number to conclude the non-normality of sample size.
- According to the above-mentioned criteria our study sample size lies in medium sample size (50< n < 300) thus the reference z-score for either skewness or kurtosis to determine the normality distribution in this study is equal to 3.29.

Although we have applied log transformation processes, where it was necessary, for dealing with negative and positive skewness its results were only slightly better than that of original (not included). Therefore, we decided to use the original data for regression analysis instead of transformed data because of a few important reasons. First, we have used the difference of performance between ERP adopters and non-adopters (by using dummy ANA) in between one year before and during, one year after, two years after and three years after performance and combined untransformed skewness for adopter and non-adopter in all above periods is meeting (or close to) at least one of above-mentioned normality criteria of skewness and kurtosis. Second important reason for using the original data is that it appears absolutely bell-shaped curve on the histogram for the majority of variable periods (please see appendix). Finally, (Feng et al., 2014) reports serious problem with log transformation. Using simulated data they demonstrated that transformed data is often not related to original data, therefore, the result may not reflect the actual effect.

5.8. Data Management

There can be certain problems related to data such as missing value, outliers, the normality of data etc. we also faced these problems while managing our sample data. We followed the standard procedures to normalize the data in order to validate the robustness of our outcomes.

5.8.1. Missing data

Missing data is one of the most frequently occurring problems for any study irrespective of nature of variables such as qualitative, dichotomous and or quantitative ratios. Missing data can question the

results' validation and or robustness. We addressed the missing value problem by using SPSS's multiple imputations, in order to effectively deal with missing values. First we analyzed the pattern to know whether or not there is a pattern to missing value data and couldn't find any systematic pattern to missing values. The question is how to generate the random number for missing values. To create iteration for these missing values, we used the random number generation that tells SPSS how we want to develop these iterations for missing value, then we specified the Mersenne Twister which is a random number generator program in SPSS. This process enabled us to perform multiple imputations for imputing missing data value. As a consequence of the above-mentioned process, SPSS creates the sequence of new imputed data sets equal to the number of imputations is selected on SPSS. The number mentioned in imputation box is 5 by default which means it will run five simulation performance in sequence and during each simulation the missing values are imputed. As in our case it is five, the simulated values are averaged together to take into account the variance of missing values.

We took into account both original and five sets of imputed data but we couldn't find any significant change in the results of regression analysis, as well as Wilcoxon paired rank test, therefore, we decided to rely on original data.

5.8.2. Outliers

Outliers are the data values that are significantly different from the rest of the data values or average of the variable. Outliers were identified and controlled in our data by using Mahalanobis' distance and cook's distance. To control the Mahalanobis' identified outliers we consult the Chi-square table at $X^2 0.05$ along with degree of freedom "df"—which depends upon the number of independent variable we have in our model, in our case it is 2 therefore df is equal 2 thus we got 5.991 number in Chi square table. For finding the acceptable cook's distance two criteria have been reported in literature. Some researchers suggest cook's distance less than or equal to ±1 (Cook & Weisberg, 1982) while other recommend Di > 4/n by total number of observations in a sample data set (Fox & Long, 1990).

In our sample data set, we used the second choice for cook's distance. We include the data that has Mahalanobis' distance value of less than 5.991 and cook's distance value equal to 4 divided by a total

number of observations in the data to control for outliers and any influential data point in regression analysis.

Chapter 6

Results

6.1. Objective of the chapter

The most important part of a study is the chapter on results. Criteria have been developed to interpret the findings and the results have been reported in the form of tables. The robustness of results has been tested through matching the outcome of the regression analysis with the outcome of the Wilcoxon analysis. The results then have been validated.

6.2. Criteria to analyze the results

In this study we adopt the following criteria, keeping in view the insights from literature to interpret the results. As mentioned above, comparing the performance of ERPs adopters in pre-to-post periods may not provide a complete picture of ERPs' effect. Suppose the performance of ERP adopters improves from pre-to-post periods, then we can claim the ERPs' positive impact. Can one still be in the position to support the ERPs positive impact in post-implementation period if non-adopters are performing even better than the adopters in the same period? Absolutely not. This indicates the importance of including the performance of matching non-adopters in the sample. Both analyses: pre-to-post of ERPs adopter's only as well as pre-to-post as compared to non-adopters' performance, can be done. We set the four main criteria to analyze the impact of ERPs are: first, diminishing performance, second, diminishing and steady, third steady and increasing and final, increasing financial performance as shown in figure 6.1A, 6.1B, 6.1C, and 6.1D respectively. These four criteria represent the positive impact of ERPs and the negative impact of ERPs based on certain outcomes for adopters and non-adopters.

6.2.1. Positive/Negative impacts of ERPs

The criteria A, B, C and D shown by figure 6.1 represent positive effect of ERP if:

- The performance of adopters and non-adopters is declining in the post-implementation period, and decrement in performance of non-adopters is more as compared to adopters. This will be considered as the positive impact of ERP if the value of variables measuring the performance is equal at one year before as shown in figure 6.1A and vice versa. Etezady (2008) investigated

the impact of ERP on the financial performance of the firm and reported declined performance of adopters and non-adopters with no significant difference in performance which signifies no impact of ERPs on the financial performance of the adopters and non-adopters.

- Hunton et al. (2003) investigate the impact of ERPs on the pre-to-post financial performance of adopters and comparative non-adopters' financial performance and find steady and declining performance for adopters and non-adopters respectively. This means that ERPs adoption helps the adopter to avoid any deterioration in financial performance that non-adopting firm couldn't thus this will be considered as the positive impact of ERPs as shown in figure 6.1B and vice versa.

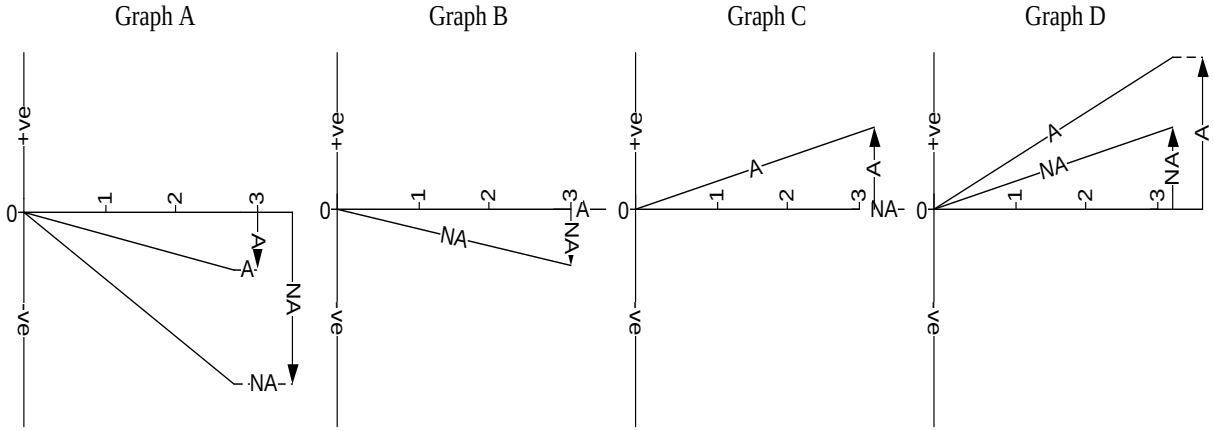


Figure 6.1: Criteria for positive impact of ERPs on financial performance of adopters

- The non-adopters' performance stays static in the post-implementation period and relative performance of ERPs adopters is increasing as shown in figure 6.1C, this shows the positive impact of ERPs that cause an increase in financial performance of adopters. Anderson et al. (2011) investigated the financial performance difference of ERPs implementation speed as compared to non-adopters and they find significant positive financial performance of accelerated (two-quarter or less) ERPs implementation as compared to moderate (3 to 4 quarters) and slow (more than 4 quarters) implementation. Hitt et al. (2002) find a significant positive impact of ERPs on financial performance as compared to non-adopters.

- The performance of adopters and non-adopters is increasing in post ERPs implementation period but the improvement in financial performance for adopters is better than non-adopters. SU et al., (2013) find significant positive pre-to-post and relative financial performance for ERPs adopters. Contrary to this, de Andres et al. (2012) concluded declined financial performance of adopters as compared to that of non-adopters in post-implementation period.

- The significant positive result for SG with a significant reduction in COGS in post ERPs implementation period, as compared to non-adopters, without significant improvement in ROS will indicate that the benefit generated from ERPs has been shared with the customer as the result of that the return on sales is unchanged. However, if we find the significant comparative variation in ROS along with significant negative change only in the COGS, then it will be treated as an indication of efficiency injected by ERPs to provide strategic support.
- Significant negative (positive) change in size will show the decrease (increase) in total assets which can be because of increase (decrease) in ROA. While interpreting the results this thing will be taken into account. But if we don't find any change in ROA along with significant increase in size of adopters will indicate consistency of generating similar ROA on additional investment.
- If firms regard the ERPs implementation to be highly risky, they may utilize more equity financing than debt financing during the ERPs implementation (Hitt et al., 2002). Significant change in debt equity ratio during the implementation of ERP for adopters will provide the answer to the question that how are the ERPs projects financed? And increase (decrease) in DER ratio during implementation period will depict somehow the pattern in which ERP is financed more by debt (equity).
- Significant change in DER during implementation will indicate the pattern of ERPs financing but a change in DER in post ERPs implementation period in connection with a significant change in size will indicate the impact of ERPs for readjustment of capital structure. The significant variation in OX in post ERPs implementation period will signify the ERPs effect on

OX and thus on operating performance. Now suppose that we can't find any significant change in TAT and find significant variation in OX. In this condition we can say the variation in OX is not powerful enough to bring the corresponding change in TAT, however, it must have the overall impact on OI of the firm.

6.3. Findings

The main question of pre-to-post analysis for this study is:

- How does ERPs implementation affect the long term financial performance of an adopting firm in Pakistan?

6.3.1. Pre-top-post analysis results

All "a" versions of all the hypotheses were intended to determine pre-to- post ERPs implementation impact on financial performance of adopters only.

The result of paired sample T-test and Wilcoxon matched pair signed rank tests witnesses no significant difference among all performance indicators, from a year before ERPs implementation to average during and three years after ERPs implementation except a few. We could find only partial support for H1a only when performance of 1YB and average during was tested through performing above mentioned tests. The results of paired sample T-test indicate a statistically significant decline in ROIC and ROS during ERP implementation period and the significance level of 0.1 for ROS by t-test couldn't be verified by Wilcoxon t-test. These results are consistent with theory that asserts a declined performance due to disturbance created by ERP implementation and learning period and impairing economic conditions in Pakistan. Although the "M1YB" and "MD" indicate deterioration of financial performance in term of ROA and ROE in Table 6.1 and Table 6.2,the results for these variables are not significant. Both tests didn't produce any significant result for any of four variables in H1a in post ERP implementation period.

The results of paired sample T-test indicate no any statistically significant value for any of rest of the hypotheses except H4a in all four periods i.e. during, one, two and three years after ERP implementation and the Wilcoxon signed rank test corroborates all the results produced by t-test for all the rest of

variables. Statistically significant increase in size throughout the four periods can be because of investment in ERP and others assets by in an effort to tackle the bad economic conditions in Pakistan. The consistency of results generated by both parametric and non-parametric tests with exactly the same statistical significance for all the variable except ROS indicates the robustness of results in this study. The results generated have provided a strong base to move on to the second stage of analysis to analyze how the similar conditions prevails in Pakistan affected the performance of non-adopters.

6.4. Validation of results

The results of any test can be validated by two different methods: cross studies comparison and cross test comparison. Both of these methods have been implied in this study.

6.4.1. Cross tests and cross studies validation of results

Findings of sample paired T-test, a parametric test, indicate no significant difference in ERPs adopters' performance in post implementation periods i.e. one, two and three years after ERPs implementation except size. The evidence for size suggests a significant increase in size of adopters throughout four periods. Another interesting finding is that the results in this study indicate a significant decline in financial performance indicators such as ROIC and ROS only during ERPs implementation periods. The result of tests are statistically insignificant for ROIC and ROS in post ERP implementation period.

The results of t-test are consistent with the findings of (Etezady, 2008; Hunton et. al. 2003) except they didn't confirm the decline indicated by any performance variables they selected.

Etezady (2008) found significant differential in cost of goods sold over sale (CGSS) using *t* test but when tested through regression analysis they couldn't get any support to verify the t-test result for Post 4 CGSS. Hunton et.al, (2003) reported that mean for performance indicators decline in post 1 and start recovering in post 2 and post 3 however the improvement from post 2 to post 3 couldn't match the pre mean level. This indicates that more time is required for ERPs adopters to cross pre mean level.

Contrary to Hunton et al., (2003), the adopter achieves the pre adoption ROA in one year after ERPs implementation and crossed ROA and ROS pre implementation performance in three years after implementation as shown in Tables 6.2 and 6.3.

Table 6.1
Paired T-test: Pre to Post performance comparison for ERP adopters

This table shows the summary of t-test results and descriptive statistics such as mean, N (number of observations). Letter V in column one shows the variable name. There are four sub-tables which represents performance results in time periods: average during, one year after (1YA), two year after (2YA) and three years after (3YA) as compared to one year before (1YB). Column one in each of four sub part of table indicates the mean one year before (M1YB) whereas second columns in each of sub-tables shows mean of average during, 1YA, 2YA and 3YA respectively. *t* value and N are *t* statistics and number of observations in each sub-table respectively.

	1YB vs During				1YB vs 1YA				1YB vs 2YA				1YB vs 3YA			
V	M1YB	MD	t-value	N	M1YB	M1YA	t-value	N	M1YB	M2YA	t-value	N	M1YB	M3YA	t-value	N
ROA	0.144	0.136	1.023	74	0.144	0.144	-0.012	71	0.143	0.14	0.3	67	0.148	0.15	-0.191	54
ROIC	0.265	0.23	2.174**	74	0.261	0.248	0.608	71	0.266	0.243	1.029	67	0.271	0.265	0.232	54
ROE	0.32	0.289	1.554	73	0.314	0.309	0.202	70	0.318	0.314	0.177	66	0.313	0.335	-0.683	53
ROS	0.113	0.101	1.951*	68	0.114	0.1	1.411	65	0.113	0.106	0.77	62	0.101	0.114	-1.222	49
TAT	1.122	1.126	-0.141	55	1.127	1.114	0.279	53	1.131	1.15	-0.345	48	1.223	1.227	-0.075	40
ITO	7.569	8.235	-0.599	58	7.802	7.763	0.029	55	8.001	7.668	0.459	51	8.982	7.627	0.709	40
DER	1.631	1.576	0.465	74	1.594	1.686	-0.559	70	1.634	1.63	0.024	67	1.494	1.551	-0.293	54
SZ	8.486	8.687	-6.229***	72	8.492	8.886	-9.089***	71	8.492	8.984	-8.63***	66	8.326	9.017	-12.111***	54
SG	1.59	2.154	-0.4	54	1.491	4.946	-1.569	49	1.329	2.957	-0.986	45	2.265	3.98	-0.718	35
OX	0.073	0.077	-1.039	69	0.072	0.071	0.331	66	0.075	0.075	0.036	63	0.077	0.075	0.337	50
COGS	0.805	0.796	0.836	72	0.804	0.817	-1.342	69	0.8	0.807	-0.667	65	0.808	0.799	0.676	53

*,**,*** represent the two-sided p-value < 0.01, < 0.05 and <0.1 respectively

Table 6.2
Wilcoxon signed rank test: Pre to Post-performance comparison for ERP adopters

This structure of this table is same as that Table 9 except this table shows Wilcoxon Z statistics instead of *t* value. This table contains results of Wilcoxon signed rank tests in each of four sub-tables which compares means of during and post ERPs implementation period with that of period before ERPs purchase decision. The purpose of Wilcoxon signed rank test (non-parametric test) to validate the results of Paired Sample *t* test (a parametric test).

	1YB vs During				1YB vs 1YA				1YB vs 2YA				1YB vs. 3YA			
V	M1YB	MD	Z-value	N	M1YB	M1YA	Z-value	N	M1YB	M2YA	Z-value	N	M1YB	M3YA	Z-value	N
ROA	0.144	0.136	-.870[b]	74	0.144	0.144	-.063[b]	71	0.143	0.14	-.012[c]	67	0.148	0.15	-.022[c]	54
ROIC	0.265	0.23**	-2.061[b]	74	0.261	0.248	-.974[b]	71	0.266	0.243	-1.168[b]	67	0.271	0.265	-.581[b]	54
ROE	0.32	0.289	-1.355[b]	73	0.314	0.309	-.366[b]	70	0.318	0.314	-.182[b]	66	0.313	0.335	-.474[c]	53
ROS	0.113	0.101	-1.528[b]	68	0.114	0.1	-.729[b]	65	0.113	0.106	-.494[b]	62	0.101	0.114	-.860[c]	49
TAT	1.122	1.126	-.084[c]	55	1.127	1.114	-.416[b]	53	1.131	1.15	-.735[c]	48	1.223	1.227	-.081[c]	40
ITO	7.569	8.235	-.352[c]	58	7.802	7.763	-.075[b]	55	8.001	7.668	-.759[b]	51	8.982	7.627	-1.223[b]	40
DER	1.631	1.576	-.547[b]	74	1.594	1.686	-.176[c]	70	1.634	1.63	-.400[b]	67	1.494	1.551	-.224[b]	54
SZ	8.486	8.687***	-5.842[c]	72	8.492	8.886***	-6.566[c]	71	8.492	8.984***	-6.289[c]	66	8.326	9.017***	-6.290[c]	54
SG	1.59	2.154	-.194[c]	54	1.491	4.946	-.612[c]	49	1.329	2.957	-.638[c]	45	2.265	3.98	-.360[c]	35
OX	0.073	0.077	-.499[c]	69	0.072	0.071	-.125[c]	66	0.075	0.075	-.096[c]	63	0.077	0.075	-.014[c]	50
COGS	0.805	0.796	-.382[b]	72	0.804	0.817	-.517[c]	69	0.8	0.807	-.474[c]	65	0.808	0.799	-.668[b]	53

*, **, *** represent the two-tailed p-value < 0.01, < 0.05 and <0.1, b represents z value based on positive ranks and c shows z value based on negative ranks.

Wilcoxon match pair signed rank test, a non-parametric test, was performed to validate the results t-test. The results of Wilcoxon t-test verify the result of t-test by confirming the same significance for all variables in all the time periods in table 6.2 except for ROS. The consistency between results of parametric and non-parametric test indicates the robustness of results in this study. The results are not consistent with those of obtained by de Andres et al (2012). They found that the average performance of ERPs adopters declines over time in one, two and three years after ERPs implementation. They also confirmed the significant performance impairment for adopters such as ROA in one year after and significant deterioration of profit margin (PM) and sales in each of three year after implementation as compared to their pre performance level. Another interesting finding by de Andres et al 2012 was the significant improvement in financial performance of non-adopters in post implementation periods.

They reported significant improvement in operating income of non-adopters, as compared to one year before, in one and two years after ERPs implementation period and significant sale growth in all post implementation periods. Etezady (2008) argues that a four years period might not be long enough to assess ERPs post implementation impact. Although, Brynjolfsson and Hitt (2003) demonstrated that IT takes three to seven years to show its contribution in firm performance, the contribution of IT may be eaten away in a longer period of time because of reactions by close competitors such as ERPs implementation decision by competitors in the same industry. Therefore three to five years period is sufficient to see the true effect of ERPs.

In order to get in-depth knowledge of the features of the adoption process, we need to analyze the components of ROIC to determine the causes of such a decline in ROIC in average during period as reported by *t* test and Wilcoxon test in Tables 6.2 and 6.3 respectively. An interesting question arising here is whether the numerator (operating income), or denominator (long term debt plus total equities) of ROIC is the cause of such a decline in ROIC. Surprisingly, we couldn't find any convincing change in the behavior of other variables except size of the firm in the same period.

The size of firm is directly related to denominator of ROIC therefore it is concluded that the difficulties during implementation of ERPs and increasing size of firm can be the main cause of such an impairment in ROIC of adopting firms.

Once the progress of ERPs adopters was analyzed though *t* test and Wilcoxon test, the comparison of performance of adopters and non-adopters in post ERPs implementation period was conducted through multiple regression analysis. This comparison allowed us to find if ERPs implementation has any effect on performance of ERPs adopters and non-adopters.

6.5. The results of Regression analysis: Relative pre-to-post financial performance

The main results of this part of study are reported in Table 6.3 to Table 6.6 which contain the results of multiple linear regression analysis which has been conducted through using the data of adopters and non-adopters. Statistics in each table provides results of four different periods such as average during (Table 6.3) to three years after (Table 6.6) ERPs implementation period as compared to pre ERPs adoption values. Although we couldn't get enough support while analyzing the pre-to-post ERPs implementation effect on financial performance of adopters, the regression analysis provided enough support for various hypotheses in this study. Keeping in the mind the purpose of this stage the second part of each table from Table 6.3 to Table 6.6 is very important because it is presenting the results of comparative performance of adopters and non-adopters in post implementation period. The results of regression analysis confirm that ERPs adopters perform significantly better than those of non-adopters in post ERPs implementation period. The results of regression analysis not only support the main performance indicators but also some explanatory components of main performance indicators. If we analyze the results from pre-to-post ERPs impact using pooled data (for adopters and non-adopters) in Table 6.3 to Table 6.6, as denoted by β_1 in upper part of each tables, a significant difference in overall performance of adopters and non-adopters can easily be noted in average during, one, two and three years after ERPs implementation.

These results are inconsistent with that of t-test and Wilcoxon test for adopters only, therefore it can be concluded that the effect of difference in pooled performance of adopters and non-adopters is actually triggered by a significant change in performance of non-adopters. Substantial difference in financial performance of ERPs non-adopters in post implementation periods.

Table 6.3
Results of Regression Analysis (Average During)

The two sections of this vertically formatted table shows the results of comparative analysis of adopters and non-adopters by comparing the performance indicators and the components of main performance indicators. The letter V in column one shows the selected variables in both sections of this table. β_0 is intercept term. β_1, β_2 and β_3 are unstandardized coefficients for pre-adoption value, size and ERPs dummy respectively. Letter t, two sided p-value in various columns of this table represents t-statistic and statistical significance level in regression analysis respectively. Last column of this table is providing adjusted R square.

	Intercept term			***Pre-adoption value***			
V	β_0	*t*	*p-value*	β_1	*t*	*p-value*	
ROA	-0.006	-0.178	0.859	0.616	10.11	.000	
ROIC	.053	1.102	.273	.537	10.759	.000	
ROE	.019	.284	.777	.394	6.558	.000	
ROS	-.054	-2.001	.048	.579	9.401	.000	
TAT	0.157	.854	.395	.873	19.543	.000	
ITO	-.176	-.086	.932	0.493	8.088	.000	
DER	-.089	-0.286	0.776	.629	12.727	.000	
SG	-.236	-.163	.871	-0.061	-2.058	.042	
OX	.031	1.733	.086	.708	13.593	.000	
COGS	.217	3.841	0.000	0.752	14.763	.000	
Size				**(ERP adopter = 1, NA = 0)**			***Adjusted R square***
V	β_2	*t*	*p-value*	β_3	*t*	*p-value*	
ROA	.004	1.121	0.264	.034	3.179	.002	.512
ROIC	.002	.389	.698	.054	2.891	.005	.543
ROE	.014	1.615	.109	.080	2.927	.004	.357
ROS	.011	3.010	.003	.008	.767	.445	.542
TAT	-0.002	-.106	.916	.134	2.253	.026	.799
ITO	.395	1.557	0.123	-.259	-.357	.722	.518
DER	.089	2.274	.025	-.164	-1.355	.178	.617
SG	.085	.469	.640	.657	1.204	.232	.429
OX	-.003	-1.316	.191	.003	.377	.707	.734
COGS	.001	0.419	0.676	-.021	-2.019	.046	.725

Table 6.4
Results of Regression Analysis (One year after)

The two sections of this vertically formatted table shows the results of comparative analysis of adopters and non-adopters by comparing the performance indicators and the components of main performance indicators. The letter V in column one shows the selected variables in both sections of this table. β_0 is intercept term. β_1, β_2 and β_3 are unstandardized coefficients for pre-adoption value, size and ERPs dummy respectively. Letter t, two sided p-value in various columns of this table represents t-statistic and statistical significance level in regression analysis respectively. Last column of this table is providing adjusted R square.

	Intercept term			***Pre-adoption value***			
V	β_0	*t*	*p-value*	β_1	*t*	*p-value*	
ROA	.013	.254	.800	.528	6.073	.000	
ROIC	-.024	-.281	.779	.464	5.779	.000	
ROE	-.123	-1.045	0.298	.354	3.753	.000	
ROS	-.037	-.790	.431	.42	4.555	.000	
TAT	.653	2.210	.029	.686	10.349	.000	
ITO	-0.55	-.193	0.847	.547	6.346	.000	
DER	.283	.441	.660	.454	5.387	.000	
SG	-6.006	-.518	0.606	.535	3.005	.004	
OX	0.06	1.802	.074	.770	9.061	.000	
COGS	.245	2.967	.004	.707	9.815	.000	
	Size			***(ERP adopter = 1, NA = 0)***			***Adjusted R square***
V	β_2	*t*	*p-value*		*t*	*p-value*	
ROA	.000	.010	.992	.052	4.135	.000	.341
ROIC	.005	.449	.654	.066	2.288	.024	.341
ROE	.019	1.326	.187	.091	2.300	.023	.250
ROS	.006	1.029	.306	.02	1.273	.206	.271
TAT	-0.043	-1.309	.193	.266	2.994	.003	.565
ITO	.446	1.313	.193	.067	.084	.933	.398
DER	.092	1.209	.229	-0.04	-.199	.843	.262
SG	.322	.232	.817	1.385	.401	.690	.076
OX	-.005	-1.241	.217	-.009	-.840	.403	.511
COGS	.006	1.147	.254	-.028	-1.935	.056	.584

Table 6.5
Results of Regression Analysis (Two years after)

The two sections of this vertically formatted table shows the results of comparative analysis of adopters and non-adopters by comparing the performance indicators and the components of main performance indicators. The letter V in column one shows the selected variables in both sections of this table. β_0 is intercept term. β_1, β_2 and β_3 are unstandardized coefficients for pre-adoption value, size and ERPs dummy respectively. Letter t, two sided p-value in various columns of this table represents t-statistic and statistical significance level in regression analysis respectively. Last column of this table is providing adjusted R square.

	Intercept term			***Pre-adoption value***			
V	β_0	*t*	*p-value*	β_1	*t*	*p-value*	
ROA	.019	.378	.706	.532	5.788	0	
ROIC	.096	1.174	.243	.387	5.176	.000	
ROE	-.047	-.414	.679	.338	3.869	.000	
ROS	-.101	-2.055	.042	.328	3.433	.001	
TAT	.668	2.311	.023	.733	11.097	.000	
ITO	2.764	.412	.682	.899	5.925	.000	
DER	.767	1.075	.285	.353	3.731	.000	
SG	-1.402	-.167	.868	.011	.074	.942	
OX	.093	2.845	.005	.815	9.837	.000	
COGS	.243	2.709	.008	.713	9.186	.000	
Size				***(ERP adopter = 1, NA = 0)***			***Adjusted R square***
V	β_2	t	p-value	β_3	t	p-value	
ROA	.000	-.085	.933	.059	3.846	.000	.304
ROIC	-.006	-.614	.541	.105	3.687	.000	.281
ROE	.012	.828	.410	.140	3.544	.001	.236
ROS	.014	2.145	.034	.038	2.245	.027	.326
TAT	-.044	-1.359	.177	.290	3.138	.002	.605
ITO	.252	.317	.752	-2.605	-1.343	.183	.298
DER	.094	1.106	.271	-.183	-.807	.421	.213
SG	-.017	-.017	.987	.858	.323	.748	.275
OX	-.008	-2.13	.035	-.017	-1.466	.145	.607
COGS	.007	1.173	.243	-.051	-3.225	.002	.548

Table 6.6
Results of Regression Analysis (Three years after)

The two sections of this vertically formatted table shows the results of comparative analysis of adopters and non-adopters by comparing the performance indicators and the components of main performance indicators. The letter V in column one shows the selected variables in both sections of this table. β_0 is intercept term. β_1, β_2 and β_3 are unstandardized coefficients for pre-adoption value, size and ERPs dummy respectively. Letter t, two sided p-value in various columns of this table represents t-statistic and statistical significance level in regression analysis respectively. Last column of this table is providing adjusted R square.

	Intercept term			***Pre-adoption value***			
V	β_0	T	p-value	β_1	t	p-value	
ROA	.042	.837	.405	.383	3.746	.000	
ROIC	.094	1.035	.304	.282	3.220	.002	
ROE	.049	.446	.657	.173	1.784	.078	
ROS	.013	.234	.816	.425	3.963	.000	
TAT	.561	1.756	.083	.733	9.821	.000	
ITO	-12.112	-1.295	0.201	.106	.630	.531	
DER	.626	.833	.407	.492	4.867	.000	
SG	-5.555	-.879	0.383	.185	1.926	.059	
OX	.026	.709	.480	.656	7.383	.000	
COGS	.354	2.809	0.006	.600	5.418	.000	
	Size			***(ERP adopter = 1, NA = 0)***			***Adjusted R square***
V	β_2	t	p-value	β_3	t	p-value	
ROA	-.005	-.77	0.444	.069	4.239	.000	.287
ROIC	.000	-.043	.966	.133	4.242	.000	.258
ROE	.012	.919	.361	.178	4.689	.000	.315
ROS	.001	.112	.911	.054	2.831	.006	.379
TAT	-.057	-1.596	0.114	.28	2.65	0.01	.593
ITO	2.448	2.231	.030	-.536	-.211	.833	.015
DER	.041	.471	.639	-.210	-.844	.401	0.257
SG	.504	.663	.510	1.193	.565	.575	0.02
OX	-.001	-.261	0.795	-.004	-.338	.736	.553
COGS	.000	.003	.997	-.056	-2.412	.018	.413

All the results in Table 6.3 to Table 6.6 for β_1 are significant except for sales growth. The positive unstandardized co-efficient for β_1 indicates that a certain percentage of sample firms perform better or worse as if they were performing better or worse in the previous period.

As mentioned above, the most important part of this stage are the lower part of each table from Table 6.3 to Table 6.6 because these parts contains the results for size and dummy variables for adopters and non-adopters which provide the verdict about which of them (adopters and non-adopters) are performing better in post ERPs implementation period. Because the size has been included to control for any effect of size on the financial performance of the firms we could observe only a few statistically significant results as shown by β_2. It is important to note here that we have also included the industry dummy, as mentioned above to control for industry effect however the results are not reported here for industry dummy. It has worth to note that initially GDP was a control variable that we used in the regression model like size in order to control for country effect. Because we couldn't find any statistically significant result of GDP, we decided to exclude GDP variable from regression model.

We couldn't find any statistically significant relationship between size and any of four main performance indicators such as ROA, ROIC, ROE and ROS. The results are inconsistent to that of evidenced by (Hunton et al., 2003) because they found a statistically significant relationship between size and ROA and ROI. The results of regression analysis clearly support Hypothesis H1b. As denoted by β_3, the unstandardized coefficients for ROA, ROIC, ROE and ROS indicates that ERPs adopters performing significantly better than non-adopters in all four periods when compared with that of pre-adoption values. Contrary to evidences reported by (de Andres et al., 2012) the results are consistent with that of shared by (Hunton et al. 2003). Hunton et al., (2003) find better financial performance as compared to that of non-adopters. The decline in the financial performance can be expected because of unstable economic conditions in Pakistan. As mentioned above the main cause of significant difference of financial performance between adopters and non-adopters is due a significant decline in ROA, ROIC, ROE and ROS of non-adopters. The results in table 6.3 for ROA confirm that the ERPs adopters perform significantly better than that of non-adopter as denoted by $\beta_3 = 0.034$, $t = 3.179$ and p-value = 0.002

during ERPs implementation period. The difference of ROA between adopters and non-adopters is getting wider. As compared to that of non-adopters, the ROA of adopters is getting even better in one, two and three years as indicated by $\beta_3 = 0.052$ (p-value = 0.000), $\beta_3 = 0.059$ (p-value = 0.000), $\beta_3 = 0.069$ (p-value = 0.000) respectively. This means, in terms of ROA, ERP adopters perform better by 3.4, 5.2, 5.9 and 6.9 percent in during, one, two and three years after ERP implementation respectively. A similar, but stronger than ROA, behavior is observed for ROIC and ROE in all four tables. The behavior of ROIC, ROE and ROS is also depicting the same pattern as that of ROA except the insignificant differential between ROS of adopters and non-adopters in during and one year after periods, however ROS differential, as indicated by β_3, become statistically significant i.e. $\beta_3 = 0.038$ (p-value = 0.027),), $\beta_3 = 0.054$ (p-value = 0.006) in table 6.6 and 6.7 respectively. While keeping in the mind the results of pre-to-post of adopters only, we can conclude that ROS of non-adopters significantly diminishes in two years after ERP implementation with a further decline in third year.

Regarding the other ratios that determine the key performance indicator in H1b, the results of multiple linear regression confirm significant better TAT for adopters in average during, one and two and three years after as compared to that of non-adopters which partially support H2b hypothesis in this study because the ITO couldn't get any significant effect for ERPs adopters over non-adopters in any post ERPs implementation period. TAT differential between ERP adopters and non-adopters is getting wider with the passage of time i.e. 13.4, 26.6, 29 and 28 percent as shown in tables 6.3, 6.4, 6.5 and 6.6 respectively.

The most interesting results of multiple linear regression confirm the significant reduction in COGS of adopters as compared to non-adopters throughout Table 6.3 to Table 6.6 which suggests that adopters COGS is significantly getting lower than that of non-adopters with the passage of time as shown in tables. The COGS for adopters as denoted by β_2 , -2.1, -2.8, -5.1 and -5.6 percent with p-value of less than 0.05 in Table 6.4 and Table 6.5 and p-value of 0.01 or less in Table 6.5 and Table 6.6 , point out significant difference in COGS of ERPs adopters as compared to that of non-adopters in post implementation periods. Although results of multiple regression analysis indicate the negative sign for

OX in three of four tables, none of value could achieve statistical significance. These results point out the partial support to hypothesis H3B.

We could not get any statistical support for H5b hypothesis which asserts reduction in DER of adopters during ERP implementation period as compared to control group because ERP is regarded as risky investment, the purpose of this hypothesis was to get the clue about the source of money which firms uses to invest in ERP. If we analyze critically the entire lower portion of Table 6.3 we can easily note a significant positive relationship between size and DER (see β_2 for DER) along with negative sign for DER as shown by β_3 which indicates that DER is declining for adopter during ERP implementation period as compared to non-adopters. The more interesting thing to note is, this is the only of DER coefficient that is significantly positively related to size and the p-value for DER as denoted by β_3 is also at its least level e.g. 0.178 in all four tables that report results of regression analysis as compared to rest three other tables. This is somehow providing the clue consistent with our hypothesis for DER, however insufficient p-value does not allow us to be confident enough to confirm the evidence for the support of this hypothesis.

Hypothesis H6b could not get any support from the results of multiple regression analysis in tables 6.3 to 6.6. Consistent with results of first stage, the SG for adopter as compared to that of non-adopter couldn't achieve statistically significant difference as denoted by β_3.

6.6. Cross studies validation of results of regression analysis

The findings in this study also qualify the other results robustness and validation criteria such as cross studies results validation. We could find the number of studies which used exactly same methodology and the findings from those studies which were conducted in the developed worlds and developing world are also valid in Pakistan. The results of this study are corroborating the findings by (Hendricks et al., 2007; Hunton et al., 2003; Tian & Xu, 2015b) from the developed world and (ChangwooPhilipLim & Yiseokhui, 2007) and (Handoko et al., 2015) from the developing world in some way or other way. If the risk is interpreted as consistency in the performance, our results are verify the result of (Tian & Xu, 2015b) because this study found no change in financial performance of ERP adopters which somehow indicatet the consistency in financial performance of the firms, whereas the performance of non-adopters is fluctuating. The results out of regression analysis in this study are in

agreement with results found by (Handoko et al., 2015) and exactly the same as found by (Hunton et al., 2003).

From the developing countries the results of this study verify the consequences of studies such as by (ChangwooPhilipLim & Yiseokhui, 2007) and (Handoko et al., 2015) because both of them found significant better performance for ERP adopters as compared to non-adopters in post ERP implementation period.

6.7. Robustness of results

The results in this study are robust based on the following arguments:

- The data have been collected directly form financial statements of firms therefore this indicate the authentication of data collected and analyzed in this study.
- The data quality has been tested through assessing the reputation of financial data publisher and sources of data from where publisher has collected the data. The sources were double checked and it was found that data has directly been taken from audited financial statements of the firms.
- The missing data problem was dealt with through multiple data imputation in SPSS in order to analyze the change in results for increased sample after multiple data imputation.
- Outliers have been removed through Mahalanobis Distance and Cooks Distance.
- Normality distribution of data has been achieved through Skewness and Kurtosis z value which indicate the normality of data distribution in this study.
- Parametric such as t-test and multiple linear regression and non-parametric test such as Wilcoxon signed rank test have generated same results with same statistical significance.
- Unlike other studies we avoid data manipulation through using averaged data. We have used actual data instead of average data except of during implementation thus we claim the results derived from actual data are better than those on derived from average data.

6.8. Strategic and operation performance of ERP adopters

The results of multiple regression analysis shows that ERP implementation generates dual effects. ERP

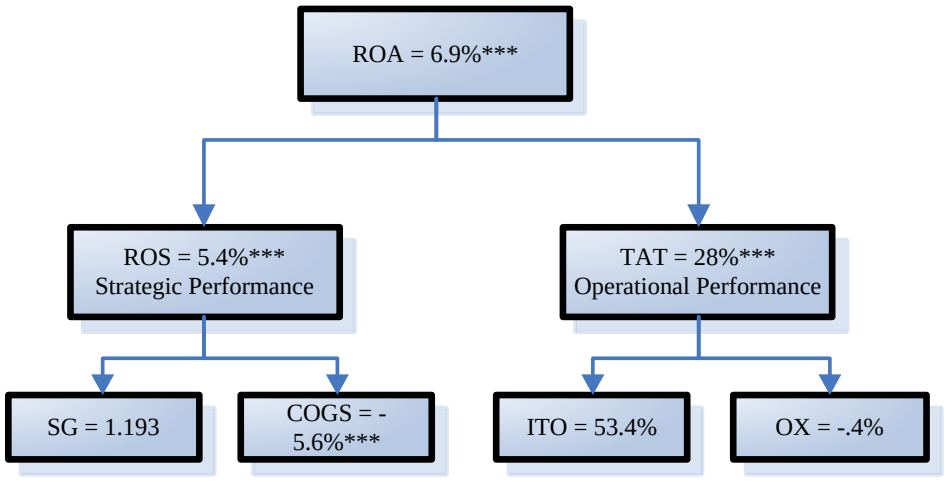


Figure 6.2: ROA and contribution of strategic and operational performance

implementation not only improves strategic performance as denoted by statistically significant coefficient for ROS and COGS but also the operational performance such as signifcantly improved total asset turnover (TAT) as illustrated by figure 6.2. The main source of achieving strategic performance is diminishing COGS instead of improved sale growth. We couldn't get any statistical significant support for two main sources of TAT, however enhanced TAT is the only source of operational performance. The analysis of figure 6.2 exposes that as compared to non-adopters, ERP adopters use both lean and agile strategies, but increase in ROS due to decrease in COGS reveals that the benefit of decreased COGS is not shared with customers.

It is important to note that the values in figure 6.2 are taken from β_3 in Table 6.6 which compares the performance of adopters with those of non-adopter while regressing the performance of all variables in period one year before over that of three years after ERP implementation. P-value of less than 0.01 is denoted by *** in figure 6.2.

6.9. Impact of ERP status on selected variables in post ERP implementation period

Figure 6.3 shows the summary of results from multiple regression analysis for β_3—which indicate the performance differential between adopters and non-adopters specifically in time t_3.

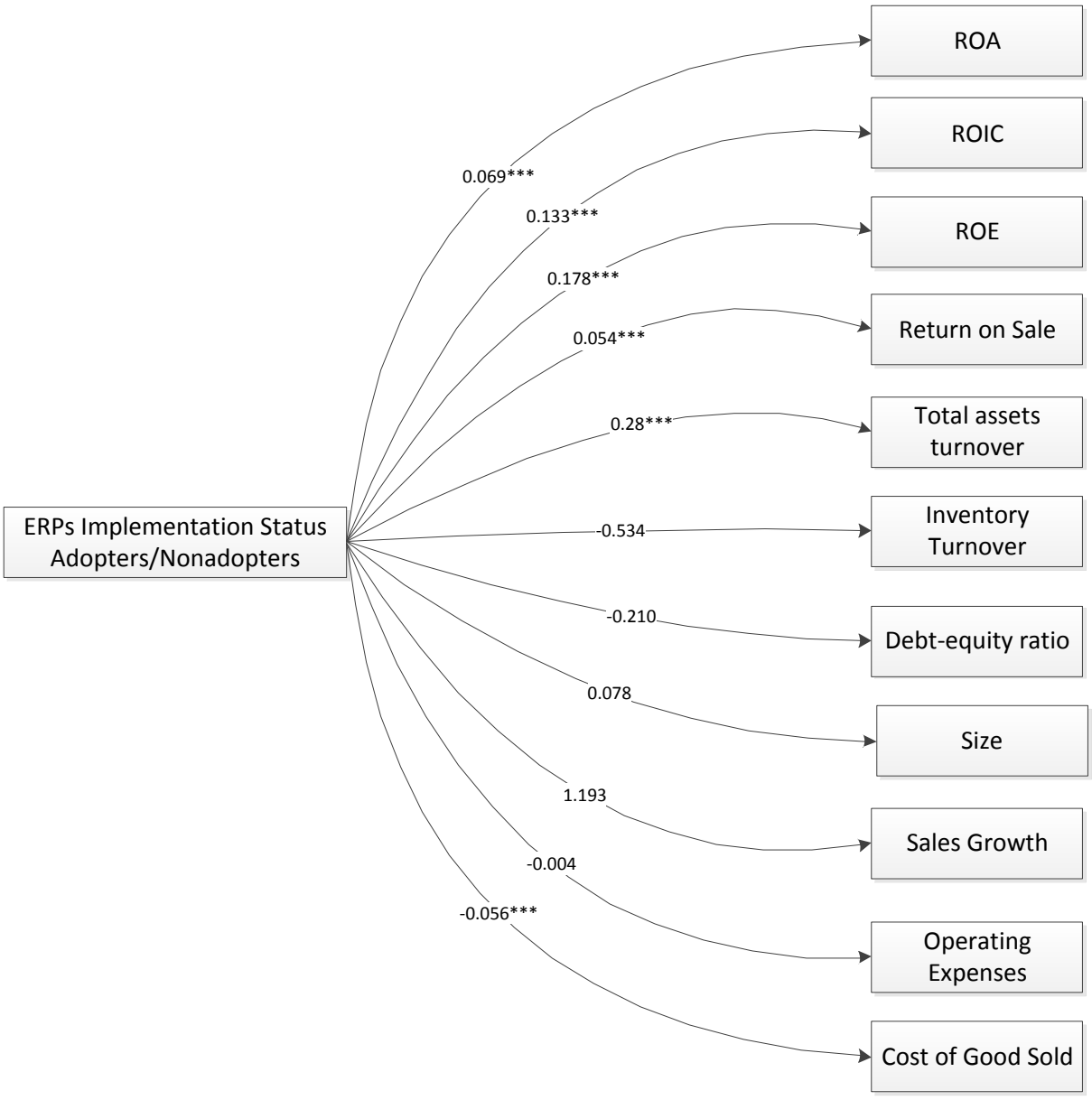


Figure 6.3: Impact of ERP status on dependent variables as compared to control group three years after ERPs implementation as compared to one year before

This figure is clearly depicting the performance differential between adopters and non-adopters. The coefficients for each variable are taken from Table 6.6. Asterisks are showing the level of statistical significance. P-value of 0.1, 0.05 and 0.01 is represented by *, ** and *** respectively. Figure 6.3 shows that ERP status has statistically significant impact on six out of eleven selected variables.

Size variable as specified in figure 6.3 has also been considered. the size difference between ERP adopters and non-adopters has been tested separately through regression analysis in order to know if there is any statistically significant difference of size between adopters and non-adopters in three years post

implementation period. The results confirm no significant difference of size between adopters and non-adopters in post ERP implementation period.

6.10. Validation of ITIVJ Model

In order to validate the ITIVJM, the values from descriptive statistics have been used and then verified from the results of regression analysis specifically for ROA. As mentioned above ROA is the most frequently used variable by studies on financial payoff of ERP implementation, therefore ROA has been used in this study to validate the proposed model in chapter 3. There are two sides of this figure which are left side and right side. The calculations have been done on the left side of figure 6.4 are based on data related to non-adopters in descriptive statistics where are calculation on right side of figure is done from the data of ERP adopters in descriptive statistics for ROA. The difference of performance, in term of ROA, in period one year before and three years after has been calculated on the right and left side of figure for adopters and non-adopter respectively.

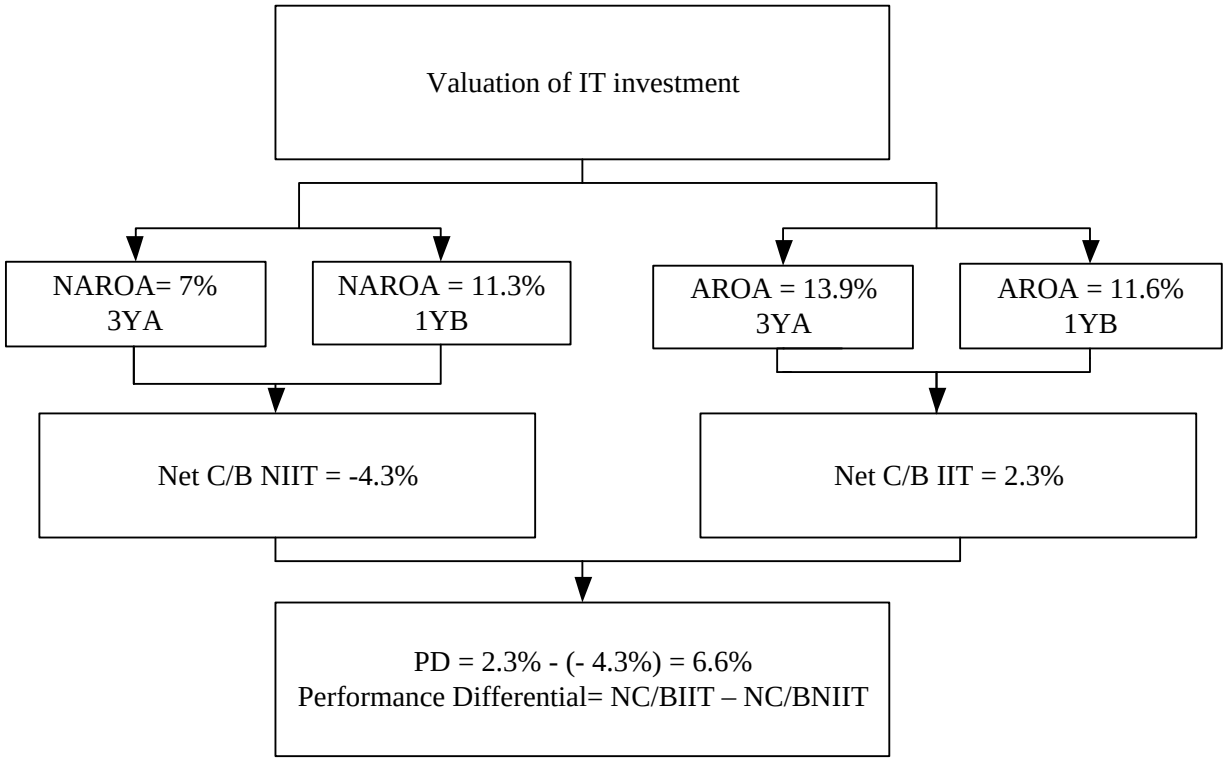
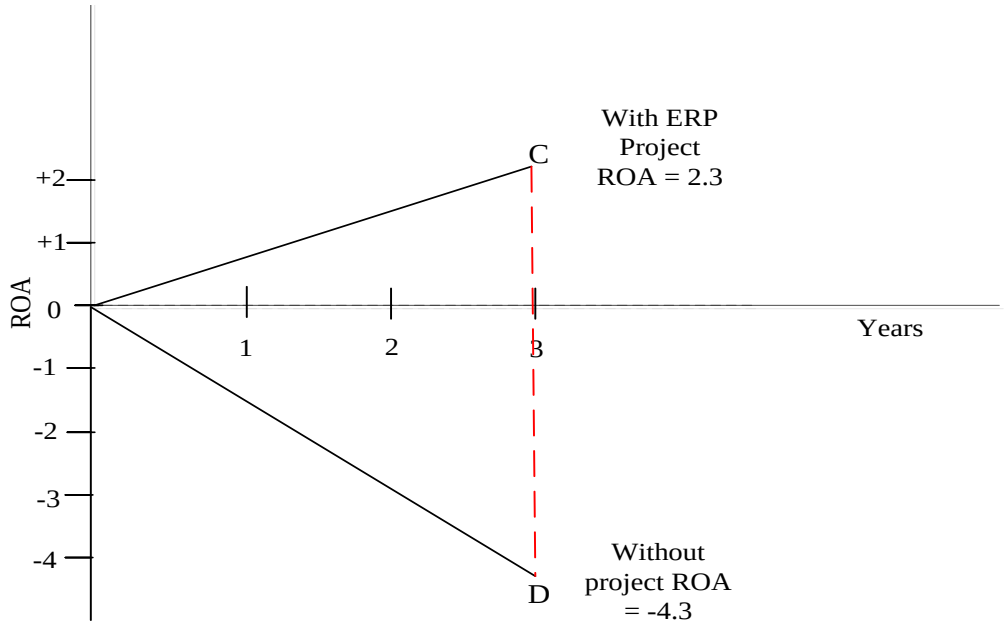


Figure 6.4: Validation of IT investment valuation and justification model.

As mentioned above the results of a separate regression analysis, in which ROA of non-adopters

regressed over ROA of adopters, confirm that ROA of adopters and non-adopters in period one year before (1YB) is very close to be exactly the same such as 11.6 percent and 11.3 percent respectively. The average ROA, in three year after (3YA) on left side of figure 6.4, for non-adopters has declined to 7 percent whereas ROA of adopters has increased to 13.9 percent. The calculations of difference in ROA on left and right sides of figure 6.4 reveal that ROA has declined by -3.4 percent for non-adopters which is cost of not investing in ERP and increased by 2.3 percent for adopters as shown by third level from top to bottom in figure 6.4 and this is the benefit of investing in ERP.



ure 6.5: Validation of with, without and before after project comparison

The difference is shown in figure 6.5 in which the vertical axis show the ROA for adopter and non-adopters and zero on vertical axis indicates the similar ROA of ERP adopters and non-adopters. +1 and +2 shows if three years after ERP implementation the ROA is better than one year before ROA and vice versa. The horizontal axis shows the time periods. As mentioned above, point C is showing the increase in average ROA of adopters and point D indicates the decline in average ROA of non-adopters in three years after ERP implementation period. The red line in between C and D in figure 6.5 indicating the ROA differential in three years after ERP implementation. 3D part of red line shows the cost of not investing in ERP whereas 3C line is depicting the benefit of ERP adoption in term of increased ROA. The results of this study are consistent with combination of criteria Graphs B and C in figure 6.1. The

overall value of red dash line in figure 6.5 is equal 6.6 percent which also supported by results of regression analysis in Table 6.6 as denoted by β_3 equal to 6.9 percent.

Chapter 7

Discussion and limitations

7.1. Objective of the chapter

The main purpose of this chapter is to answer the questions that have been posed in the introduction section of this study. Questions such as "does ERPs implementation affect the financial performance of adopters and non-adopters in Pakistan?", "does ERP implementation create operational benefit for adopters as compared to non-adopters?" , "does ERPs implementation offers strategic benefit to adopters as compared to non-adopters?" and other questions related to literature. The chapter also discusses implications of this study.

7.2. Discussion

Implementing ERPs is a way to integrate all business units, provide real-time data for timely decision, speeding up production and supply in the market, decrease assets needed to run the business, maximize customer satisfaction etc. for improving firm performance. ERPs investment tends to achieve strategic and operational goals of firm which ultimately reveal improved financial performance for adopters. A good number of issues at different stages of ERPs implementation have been reported by prior studies. We have tried to respond to the fundamental classification done by (Melville et al., 2004) and (Schryen, 2013). We controlled for factors according to (Melville et al., 2004) affect the output of IT. We strictly focus on all three questions posed by (Schryen, 2013). The first question is what do we know? the answer is the literature that we synthesized to develop the concept of cost of not investing is contribution by answering the second question of (Schryen, 2013) such as what we still need to know? This study has contributed through producing an example that determine the path to reach such as answer to the third question such as how can we get there. However, the important gap is still remaining while evaluating and justifying ERPs investment project.

A huge number of techniques have been proposed for evaluation of Information Technology Projects but past evolution in traditional or newly proposed techniques could not consider the overall business value of an IT investment. A review of the literature reveals that almost all the traditional and the newly

proposed techniques focus on the question: what will be the value (quantitative and qualitative benefits and costs) of an IT project if a firm invests in it? The flip part of this question such as what will be the cost if the firm does not invest in that IT project has been ignored by those techniques. Oz (2005) argues that "If today a firm does not use PCs, it will simply not survive". This reflects that the costs of not investing in IT may be greater than that of costs and benefits of investing in it. Thus considering only costs and benefits (quantitative and qualitative) of investing in IT may not provide the true value of IT investment. The actual overall value of an IT investment may be achieved through determining the expected firm's value with and without any IT project. Therefore, we propose the model to consider the value of the firm with and without IT project. We also demonstrate how this model will affect selection process and may be integrated with traditional financial techniques such as Net Present Value, Payback Period etc. and newly proposed techniques such as RO to effectively bring the true and actual picture of the firm value for making optimal IT project selection.

Modern enterprise-wide information systems (ES) permit companies to support their market strategies, and the role of ES's in achieving these is difficult to overstate. However, when discussing the analysis of investments in ES many authors seem to forget this role as an enabler and treat the investment in ES as a separate project. An investment in IT is for a production or service company never a goal in itself, but always part of a larger project aiming at improving the company's business processes, which in turn aim at implementing and supporting the company's strategy. In the end this has to result in an improvement of its economic value added (EVA) compared to the scenario of not investing. We develop an ex ante investment analysis framework that starts from the effects of ES on operational activities and arrives at EVA via the strategic activities supported. After developing such linkage base on reasoning we apply the "with and without" scenarios analysis to determine the actual value and help decision maker to take justifiable ERP investment decision. The comparison between with and without ERP investment scenarios will enable the firm to determine the actual value from ERP investment. This will enable NPV or any other traditional techniques as part of total investment analysis.

A scarce number of studies has been devoted to investigate the post ERPs implementation effect on financial performance of firms in the developing world in general (Kossaï & Piget, 2014) and in

Pakistan in particular (Shaukat, 2009). To the best of our knowledge, we couldn't find even a single study in Pakistan that investigated the impact of ERPs on financial performance of adopters and non-adopters in Pakistan. The reason is definitely the difficulty in accessing required data related to ERPs. This has further increased our interest to investigate the issue in order to be the first study to investigate the issue in Pakistan.

The notion of cost of not investing that we drew from literature review has got statistical support in this study in the form of a slight improvement in financial performance of ERPs adopters in third year after implementation along with the huge decline in financial performance of non-adopters. The findings in this study also support the hypotheses which state ERPs brings not only operating improvements but also strategic benefits which ultimately cultivate financial benefits.

The outcomes of this study are consistent with that found by (Hendricks et al., 2007; Hunton et al., 2003). ERPs investment generates a dual effect: it is not only providing the strategic edge to adopters by reducing COGS through our sample periods but also provide the operating benefit through reduced operating expense in third year after ERPs implementation. The important finding indicates that the performance gap between ERPs adopters and non-adopters will be getting wider with the passage of time. Keeping the t test result in mind it can be concluded that ERPs implementation shield the adopters from deteriorating their performance in bearish market situation. The results about ERPs implementation impact on financial perform drawn by studies in developed world as well as in developing world are valid in the case of Pakistan. The results are also in accordance with (ChangwooPhilipLim & Yiseokhui, 2007) who found significant improvement in financial performance of adopters as compared to non-adopters in post ERPs implementation period. Because the results of ERPs' effect on financial performance of adopters and non-adopters are mixed,our results are consistent with some findings in the developed and developing world while contrary to other studies conducted in the both parts of the worlds.

7.3. Limitations

In order to offer a better understanding of results we must present limitations of this research.

- First, the data for ERPs implementation duration was missing therefore ERP implementation period has been estimated in this study instead using mean of original implementation period. It may be possible that ERP implementation period may be greater than two years for some firms and less than a year for other firms as mentioned in literature.
- Second, we dealt with missing financial data through multiple data imputation but random data generation by automated computer program may not be similar to that of actual missing data.
- Third, unannounced ERP implementation by firms in Pakistan might be implemented years before and reported accumulated depreciation might be recorded years after implementation.
- Fourth, due to the data availability restriction, we could consider the time span of only three years after implementation.
- Fifth, a significant decline in sample size of ERPs firm due to missing financial data for the adopters thus we couldn't maintain the same sample for each analysis.
- Sixth, we could not make distinction between the firms that adopted modules of ERP and ERP complete suite due to unavailability of data therefore we couldn't test the impact of ERP implementation scope on the financial performance of the firm.

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Chapter 8

Conclusion

8.1. Objective of the chapter

The aim of this chapter is to sum up the whole story and provide the summary of new things found and how the findings contribute in the literature on performance effect of ERP. Finally, it identifies the gaps that this research offers for future research.

8.2. Summary

Although it has been examined many times what is the cost and benefits of IT investment in general and ERP in particular, the cost of not investing in IT and or ERP has been missing in the literature. We recognize that Davern (2009) just indicated lost opportunity and opportunity taken by rival can be the cost of not making timely investment decision in technology while investigating technology investment impact in four case studies however he didn't say anything about cost of not investing. Identifying the cost of not investing IT, how considering cost of not investing can make the difference in making investment decision and developing and applying framework on a numerical example and incorporating the cost of not investing in NPV has been the first purpose of this study.

Secondly, we provided a framework to identify and evaluate the expected cost and benefit of investing and not investing in ERP in order to know what can be the benefit of ERP at planning stage while addressing the different issues related to ERP implementation decision.

The ERP systems have been dispersed worldwide rapidly for the last years. In this era of enterprise systems most of the multinational firms have deployed ERP. This rapid ERP diffusion motivated researchers (such as Poston and Grabski, 2001; Hunton et al., 2003; de Andres et al., 2012 etc.) to assess the ERP innovation diffusion process.

Such ERP implementation spread has also been observed in Pakistan. However, it must be considered that every country has its unique properties such as national culture, management technological skill, language etc. and so has Pakistan. Therefore findings of prior studies conducted on the impact of ERP

implementation on financial performance of the firm in any other country cannot be generalized immediately to Pakistan.

Probing the financial pay-off of IT has remained interesting and a hot issue for recent decades. A decent number of studies have been devoted to analyze productivity paradox however the studies to examine the financial performance impact of ERPs are scarce. The majority of that scarce work on this important issue has been done in the developed world such as US, Europe, Japan etc. Very little research work has been done on ERP's financial impact in the developing world. Thus study is devoted to investigate the impact of ERPs implementation on financial performance of the firm for generating empirical evidence with advantage of being first study to investigate the issue in Pakistan. These are the main drivers behind this research.

Following the prior studies such as conducted by Hunton et al., 2003 and de Andres et al., 2012 etc. we use a matched pairs based research design to investigate the productivity paradox. The financial performance of non-adopter is expected to diminish as compared to adopters under productivity paradox assumption. This study assesses the change in financial performance of adopters and non-adopters from a year before to during (average of two years estimated period for during), one, two and three years after ERP implementation.

In this study, the financial data of ERP adopters and non-adopters registered at Karachi Stock Exchange (renamed as Pakistan Stock Exchange) from 2000 to 2013 in above mentioned setting has been analyzed using parametric and non-parametric tests. The main results of parametric tests such as t-test and multiple linear regression analysis and non-parametric test such as Wilcoxon paired rank test show no significant pre to through and post change in financial performance of adopters. However the non-adopting firms experienced a significant performance impairment in through and post implementation period as denoted by ROA, ROIC, ROE and ROS. The main cause of relative worse performance of ERP non-adopters is significant increase in the OX and COGS. Interestingly, no change is found in the financial performance of adopters. So it can be concluded that the productivity paradox is supported in this study, by which we mean no change in financial performance of ERPs adopters if we consider the adopters only; but we can conclude no support for productivity paradox if we take into account the

relative performance of adopters as compared to non-adopters because multiple linear regression clearly indicates better relative performance of adopters. This confirms that ERP implementation generates dual relative effects for adopters such as strategic benefit in term of reduced relative COGS and operational benefit in form of diminished OX.

One of the very interesting findings generated in this study is the cost of not investing in ERP in the form of significant decline in the financial performance of non-adopters in post ERPs implementation period as compared to that of adopters. The in depth analysis of data reveals that ERP implementation generates a dual effect which not only produces the operational financial benefits but also strategic financial benefits. The results also confirm that the benefits of ERPs are not shared with customers by Pakistani adopters.

The results of this study could provide valid indication about the impact of ERP implementation in countries whose culture resembles that of Pakistan (such as India, Bangladesh, Iran, Sri Lanka).

The main limitations include the span of time after implementation of ERP is three years in this study which can be expanded for longer period of time to get the insight for ERP impact in post implementation period longer than three to five years. We can't explain the cause of change in operating expense and COGS of non-adopting firms at gross root level to understand the main reasons which lead changes in these two variables.

8.3. Future research

It will be interesting to compare post ERP implementation effect of two different industries. The industries selection can be on the basis of ERPs implementation strength to examine the impact of ERP implementation strength in an industry on financial performance of the firms in that industry. In order to examine the long term ERP implementation impact of ERP on financial performance a longer than three years interval should be taken in post implementation period. In order to get deep understanding of which component causes change in operating expense of non-adopters more data may be used. The ITIVJM model has been proposed and validated through literature review and results of this study. This model can be tested at case study level to deeply evaluate and test the validity of the model at particular

case study level. Although this study discussed the cultural and other factors, we couldn't collect the data for different cultural factors in order analyze the impact of cultural factors on ERP implementation and thus on organization performance. We recommend to test the impact of cultural effect on ERP implementation and cost of not investing in ERP.

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Appendix A

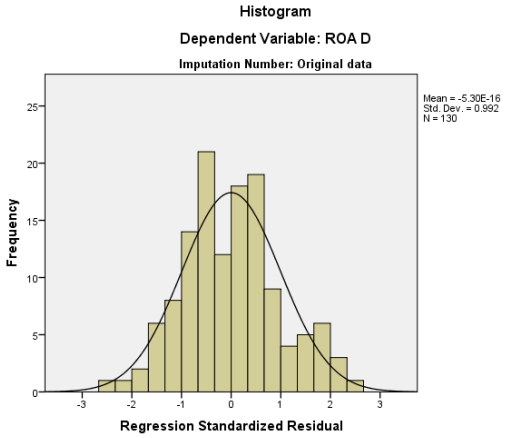
Accord Textiles Ltd.					(Million Rupees)			
Items	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
A.Capital Structure:								
1.Ordinary Share Capital	**93.0**	**93.0**	**93.0**	**93.0**	**93.0**	**93.0**	93.0	93.0
2.Surplus	**-361.9**	**-361.2**	**-394.8**	**-427.3**	**-481.2**	**-319.2**	-81.8	-405.2
3.Shareholder's Equity (A1+A2)	**-268.9**	**-268.2**	**-301.8**	**-334.3**	**-388.2**	**-226.2**	11.2	-312.2
4.Prefrence Shares							0.0	0.0
5.Debentures	**0.8**						0.0	0.0
6.Other Fixed Laibilities	**428.6**	**457.9**	**414.7**	**367.2**	**320.4**	**418.5**	179.3	81.0
7.Total Fixed Laibilities (A4+A5+A6)	**429.4**	**457.9**	**414.7**	**367.2**	**320.4**	**418.5**	179.3	81.0
8.Total Capital Employed (A3+A7)	**160.5**	**189.7**	**112.9**	**32.9**	**-67.8**	**192.3**	190.5	-231.2
B.Liquidity:								
1.Liquid Assets:	**1.4**	**2.2**	**2.5**	**0.4**	**14.1**	**8.2**	2.7	2.2
(Ruiz-Mercader et al.)Cash	**1.4**	**2.2**	**2.5**	**0.4**	**14.1**	**8.2**	2.7	2.2
(II)Investments							0.0	0.0
2.Other Current Assets	**34.1**	**37.9**	**42.7**	**27.6**	**15.4**	**28.0**	21.2	28.9
3.Inventories					**11.4**	**47.5**	63.0	69.0
4.Current Assets (B1+B2+B3)	**35.5**	**40.1**	**45.2**	**28.0**	**40.9**	**83.7**	86.9	100.1
5.Current Liabilities	**270.8**	**226.6**	**291.1**	**336.0**	**432.2**	**198.7**	199.5	618.9
6.Total Liabilities(A7+B5)	**700.2**	**684.5**	**705.8**	**703.2**	**752.6**	**617.2**	378.8	699.9
7.Net Current Assets(B4-B5)	**-235.3**	**-186.5**	**-245.9**	**-308.0**	**-391.3**	**-115.0**	-112.6	-518.8
8.Contractual Liabilities	**429.4**	**457.9**	**480.6**	**430.4**	**425.8**	**607.0**	216.9	192.2
9.Net liquid assets (B1-B5)	**-269.4**	**-224.4**	**-288.6**	**-335.6**	**-418.1**	**-190.5**	-196.8	-616.7
C.Fixed Assets:								
1.Fixed Asset At Cost	**449.2**	**448.8**	**450.4**	**450.7**	**449.9**	**449.6**	457.1	456.5
2.Fixed assets after deducting accumulated depreciation	**395.8**	**376.2**	**358.7**	**340.9**	**323.5**	**307.2**	302.9	287.8
3.Depreciation for the year	**21.3**	**20.3**	**19.1**	**18.1**	**17.1**	**16.2**	11.8	15.1
4.Total assets (B4+C2)	**431.3**	**416.3**	**403.9**	**368.9**	**364.4**	**390.9**	389.8	387.9
D.Operation:								
1.Gross sales	**226.6**	**219.4**	**277.3**	**253.5**	**268.5**	**273.2**	192.4	269.3
(Ruiz-Mercader et al.)Local sales	**226.6**	**219.4**	**277.3**	**253.5**	**268.5**	**273.2**	192.4	269.3
(Ruiz-Mercader et al.)Export sales							0.0	0.0
2.Cost of Sales	**258.5**	**207.9**	**295.8**	**275.8**	**304.3**	**303.0**	210.4	306.9
3.Gross profit	**-31.9**	**11.5**	**-18.5**	**-22.3**	**-35.8**	**-29.8**	-18.0	-37.6
4.Overhead and Other Expenses	**299.3**	**219.2**	**301.7**	**282.4**	**304.3**	**308.9**	214.4	311.6
5.Operating profit	**-70.3**	**6.5**	**-22.5**	**-26.5**	**-35.7**	**-16.5**	-22.0	1.5
6.Financial expenses			**7.5**	**8.0**		**1.1**	0.0	2.6
7.Net profit before tax (D5-D6)	**-70.3**	**6.5**	**-30.0**	**-34.5**	**-35.7**	**-17.6**	-22.0	-1.1
8.Tax provision	**1.1**	**1.1**	**1.2**	**1.1**	**1.3**	**1.4**	0.8	1.3
9.Total amount of dividend		**2.3**					0.0	0.0
10.Total value of bonus shares issued							0.0	0.0

E.Sources of Increase In Capital Employed:								
1.Increase/decrease in capital employed (A8 - A8 of preceding year)	**-79.0**	**29.2**	**-76.8**	**-80.0**	**-100.7**	**260.1**	-1.8	-421.7
2.Retention in business (D7-D8-D9)	**-71.4**	**3.1**	**-31.2**	**-35.6**	**-37.0**	**-19.0**	-22.8	-2.4
3.Finance from outside the company (E1-E2)	**-7.6**	**26.1**	**-45.6**	**-44.4**	**-63.7**	**279.1**	21.0	-419.3
F.Cash Flow Data								
1.Depreciation for the year plus retention in business: cash flow (C3+E2)	**-50.1**	**23.4**	**-12.1**	**-17.5**	**-19.9**	**-2.8**	-11.0	12.7
2.Depreciation for the year plus changes in capital employed (C3+E1)	**-57.7**	**49.5**	**-57.7**	**-61.9**	**-83.6**	**276.3**	10.0	-406.6
G.Operating Financial & Investment Ratios:								
1.Gearing ratio (A7 as % of A8)	**267.5**	**241.4**	**367.3**	**1116.1**	**-472.6**	**217.6**	94.1	0.0
2.Current ratio (B4 as % of B5)	**13.1**	**17.7**	**15.5**	**8.3**	**9.5**	**42.1**	43.6	16.2
3.Acid test or Quick ratio (B4-B3 as % B5)	**13.1**	**17.7**	**15.5**	**8.3**	**6.8**	**18.2**	12.0	5.0
4.Debt equity ratio (B6 as % of A3)	**-260.4**	**-255.2**	**-233.9**	**-210.3**	**-193.9**	**-272.9**	3382.1	0.0
5.Return on assets (D7 as % of C4)	**-16.3**	**1.6**	**-7.4**	**-9.4**	**-9.8**	**-4.5**	-5.6	-0.3
6.Self financing ratio (E2 as % of E1)	**90.4**	**10.6**	**40.6**	**44.5**	**36.7**	**-7.3**	-	0.6
7.Cash flow ratio F1 as % of F2	**86.8**	**47.3**	**21.0**	**28.3**	**23.8**	**-1.0**	-110.0	-3.1
8.Shareholders equity as % of ordinary share capital (A3 as % of A1)	**-289.1**	**-288.4**	**-324.5**	**-359.5**	**-417.4**	**-243.2**	12.0	-335.7
9.Overhead and other expenses as % of gross sales (D4 as % D1)	**132.1**	**99.9**	**108.8**	**111.4**	**113.3**	**113.1**	111.4	115.7
10.Financial expenses as % of operating profit (D6 as % of D5)	**-33.3**	**-30.2**		**-6.7**	-	173.3	-2.8	
11.Financial expense as % of gross sales (D6 as % of D1)	**2.7**	**3.2**		**0.4**	0.0	1.0	0.2	
12.Financial expenses as % of contractual liabilities (D6 as % B8)	**1.6**	**1.9**		**0.2**	0.0	1.4	0.3	
13.Tax provision as % of net pre-tax profit (D8 as % of D7)	**-1.6**	**16.9**	**-4.0**	**-3.2**	**-3.6**	**-8.0**	-	-118.2
14.Sundry debtors as % of gross sales	**0.3**	**0.4**	**1.1**	**3.0**	**3.4**	**0.8**	1.1	0.9
15.Net profit as % of shareholders' equity (D7 as % of A3)	**26.1**	**-2.4**	**9.9**	**10.3**	**9.2**	**7.8**	-196.4	0.0
H.Key Performance Indicators:								
1.Dividend cover ratio [(D7 - D8) as % of D9]		**234.8**					-	0.0
2.Dividend ratio to equity (D9 as % of A3)		**-0.9**					0.0	0.0
3.Net profit margin (D7 as % of D1)	**-31.0**	**3.0**	**-10.8**	**-13.6**	**-13.3**	**-6.4**	-11.4	-0.4
4.Earning per share before tax (D7/No. of ordinary shares)	**-7.6**	**0.7**	**-3.2**	**-3.7**	**-3.8**	**-1.9**	-2.4	-0.1
5.Earning per share after tax [(D7-D8)/No. of ordinary shares]	**-7.7**	**0.6**	**-3.4**	**-3.8**	**-4.0**	**-2.0**	-2.5	-0.3
6.Average annual % depreciation on written down fixed assets	**5.1**	**5.1**	**5.1**	**5.0**	**5.0**	**5.0**	3.8	5.0
7.Sales as % of total assets (D1 as % of C4)	**52.5**	**52.7**	**68.7**	**68.7**	**73.7**	**69.9**	49.4	69.4
8.Earning per share before tax growth (current year EPS - last year EPS/ last year EPS)	**-22.7**	**-109.2**	**-557.1**	**15.6**	**5.4**	**-50.0**	26.3	-95.8
9.Sales growth (current year's 'sales - last year's sales / last year's sales)	**-5.2**	**-3.2**	**26.4**	**-8.6**	**5.9**	**1.8**	-29.6	40.0
10.Break-up value of ordinary shares (in rupees)	**-28.9**	**-28.8**	**-32.5**	**-35.9**	**-41.7**	**-24.3**	1.2	-33.6

Kohinoor Mills Ltd. **(Thousand Rupees)**

Items	2006	2007	2008	2009	2010	2011
A.Non-Current Assets (A1+A3+A5+A6+A7)	4,104,627	4,104,627	4,104,627	5,628,504	5,416,869	3,306,413
1.Capital work in progress	-	-	-	76,674	42,653	31,501
2.Operating fixed assets at cost	5,561,093	5,561,093	5,561,093	7,643,941	7,734,568	5,302,144
3.Operating fixed assets after deducting accumulated depreciation	4,099,627	4,099,627	4,099,627	5,483,273	5,299,081	3,214,533
4.Depreciation for the year	268,132	268,132	268,132	272,679	323,789	250,424
5.Intangible assets	5,000	5,000	5,000	42,474	40,452	36,688
6.Long term investments	-	-	-	0	0	0
7.Other non-current assets	-	-	-	26,083	34,683	23,691
B.Current Assets (B1+B2+B3+B4+B5)	3,718,892	3,718,892	3,718,892	3,415,467	3,240,985	2,439,638
1.Cash & bank balance	181,197	181,197	181,197	281,229	76,535	231,874
2.Inventories	1,614,546	1,614,546	1,614,546	1,226,956	1,143,915	521,462
3.Trade Debt	1,038,802	1,038,802	1,038,802	872,369	774,727	498,803
4.Short term investments	275,634	275,634	275,634	172,526	272,264	77,889
5.Other current assets	608,713	608,713	608,713	862,387	973,544	1,109,611
C.Current Liabilities (C1+C2)	4,679,882	4,679,882	4,679,882	6,150,478	7,363,807	6,376,888
1.Short term Secured loans	3,645,542	3,645,542	3,645,542	4,782,795	5,432,644	4,450,186
2.Other current liabilities	1,034,340	1,034,340	1,034,340	1,367,683	1,931,163	1,926,702
D.Non-Current Liabilities (D1+D2+D3+D4+D5)	1,438,956	1,438,956	1,438,956	1,016,955	438,911	31,085
1.Long term secured loans	-	-	-	948,092	346,049	0
2.Long term unsecured loans	-	-	-	0	0	0
3.Debentures/TFCs	119,997	119,997	119,997	0	0	0
4.Employees benefit obligations	-	-	-	0	0	0
5.Other non-current liabilities	1,318,959	1,318,959	1,318,959	68,863	92,862	31,085
E.Shareholders Equity (E1+E2+E3)	1,704,681	1,704,681	1,704,681	1,876,538	855,136	(661,922)
1.Issued, Subscribed & Paid up capital	330,591	330,591	330,591	509,110	509,110	509,110
i).Ordinary Shares	330,591	330,591	330,591	509,110	509,110	509,110
ii).Preference shares	0	0	0	0	0	0
2.Reserves	1,374,090	1,374,090	1,374,090	330,102	(678,127)	(1,867,570)
i).Capital Reserve	-	-	-	242,870	386,720	253,237
ii).Revenue Reserve	-	-	-	87,232	(1,064,847)	(2,120,806)
3.Surplus on revaluation of fixed assets	-	-	-	1,037,326	1,024,153	696,538
F.Operation:						
1.Sales	6,450,087	6,450,087	6,450,087	7,708,699	6,411,544	5,389,231
i).Local sales (Net)	1,346,094	1,346,094	1,346,094	2,248,052	1,693,738	1,243,102
ii).Export Sales (Net)	5,103,993	5,103,993	5,103,993	5,460,647	4,717,806	4,146,129
2.Cost of sales	5,728,198	5,728,198	5,728,198	7,032,940	6,058,012	5,457,331
i).Cost of material	-	-	-	5,364,632	4,164,184	3,221,349
ii).Other input cost	-	-	-	1,668,308	1,893,828	2,235,982
3.Gross Profit	721,889	721,889	721,889	675,759	353,532	(68,100)

4.General, administrative and other expenses	347,377	347,377	347,377	974,488	827,008	745,348
i).Selling & distribution expenses	-	-	-	502,178	429,616	368,622
ii).Administrative and other expenses	347,377	347,377	347,377	472,310	397,392	376,726
5.Salaries, wages and employee benefits	-	-	-	590,395	469,125	321,167
6.Financial expenses	408,655	408,655	408,655	706,782	724,448	623,162
of which: (i) Interest expenses	-	-	-	610,484	650,049	568,444
7.Net profit before tax	6,049	6,049	6,049	(694,889)	(1,118,973)	(1,234,472)
8.Tax expense (current year)	59,218	59,218	59,218	54,340	55,513	45,370
9.Total amount of dividend	0	0	0	0	0	0
10.Total value of bonus shares issued	0	0	0	0	0	0
11.Cash flows from operations	-	-	-	329,628	(152,705)	(487,242)
G.Miscellaneous						
1.Total capital employed (E+D)	3,143,637	3,143,637	3,143,637	2,893,492	1,294,047	(630,837)
2.Total fixed liabilities (D1+D3)	119,997	119,997	119,997	948,092	346,049	0
3.Retention in business (F7-F8-F9)	(53,169)	(53,169)	(53,169)	(749,229)	(1,174,486)	(1,279,842)
4.Contractual Liabilities (G2+C1)	3,765,539	3,765,539	3,765,539	5,730,887	5,778,693	4,450,186
H.Key Performance Indicators						
1.Acid test or quick ratio[(B1+B3+B4) to C]	0.32	0.32	0.32	0.22	0.15	0.13
2.Financial expenses as % of sales (F6 as % of F1)	6.34	6.34	6.34	9.17	11.30	11.56
3.Trade Debt as % of sales (B3 as % of F1)	16.11	16.11	16.11	11.32	12.08	9.26
4.Assets turnover ratio [F1 to (A+B)]	0.82	0.82	0.82	0.85	0.74	0.94
5.Current ratio (B to C)	0.79	0.79	0.79	0.56	0.44	0.38
6.Cost of goods sold to sales (F2 as % of F1)	88.81	88.81	88.81	91.23	94.49	101.26
7.Debt equity ratio [(C+D) to E]	3.59	3.59	3.59	3.82	9.12	-9.68
8.Return on assets [F7 as % of avg.(A+B)]	0.08	0.08	0.08	-8.24	-12.64	-17.14
9.Return of equity (F7 as % of avg. E)	0.36	0.35	0.35	-38.81	-81.93	-1,277.82
10.Return on capital employed (F7 as % of avg. G1)	0.18	0.19	0.19	-23.02	-53.44	-372.27
11.Dividend cover ratio [(F7-F8) to F9]	-	-	-	-	-	-
12.Inventory Turnover Ratio (F1 to B2)	3.99	3.99	3.99	6.28	5.60	10.33
13.Interest cover ratio [(F7+ F6(i)) to F6(i)]	-	-	-	-0.14	-0.72	-1.17
14.Net profit margin (F7 as % of F1)	0.09	0.09	0.09	-9.01	-17.45	-22.91
15.Operating cash flow to debt ratio [F11 to (C+D)]	0.00	0.00	0.00	0.05	-0.02	-0.08
16.Earning per share after tax (Rs./share) [(F7-F8)/No. of Ord. shares]	-1.61	-1.61	-1.61	-14.72	-23.07	-25.14
17.Break-up value shares (Rs./share) (E/No. of Ord. shares)	51.56	51.56	51.56	36.86	16.80	-13.00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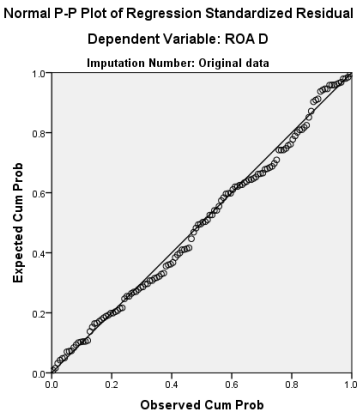
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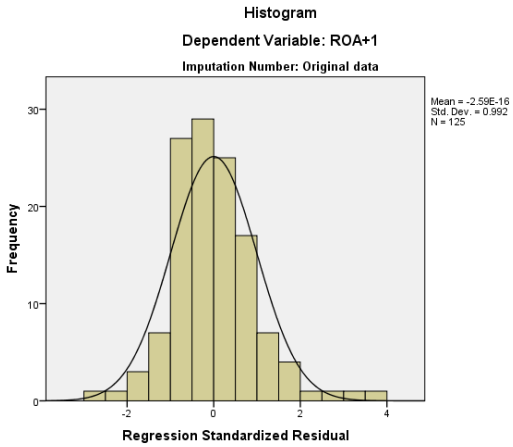
Observed Cum Prob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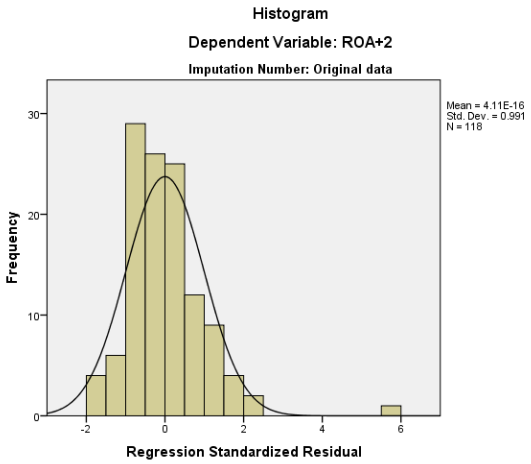
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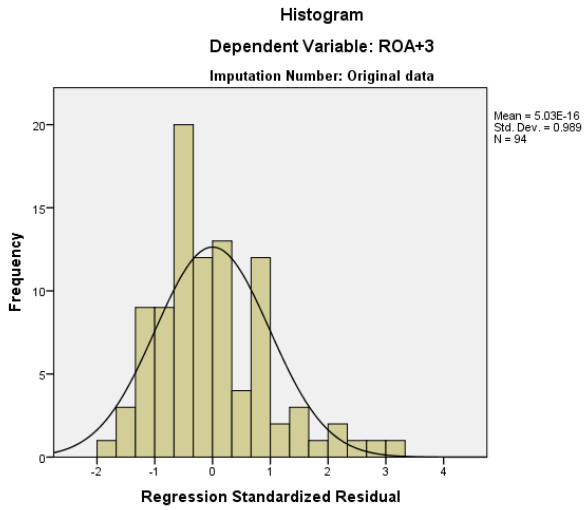
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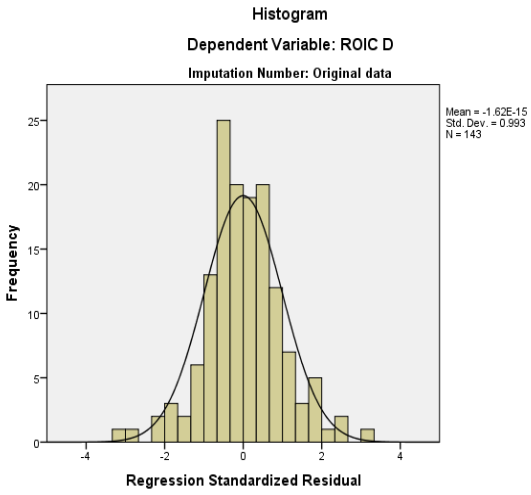
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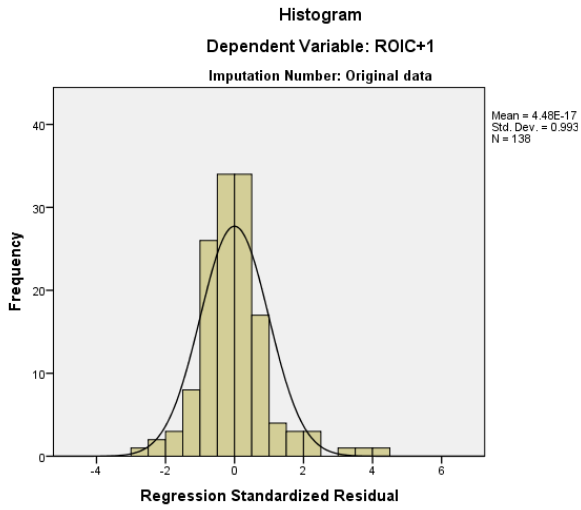
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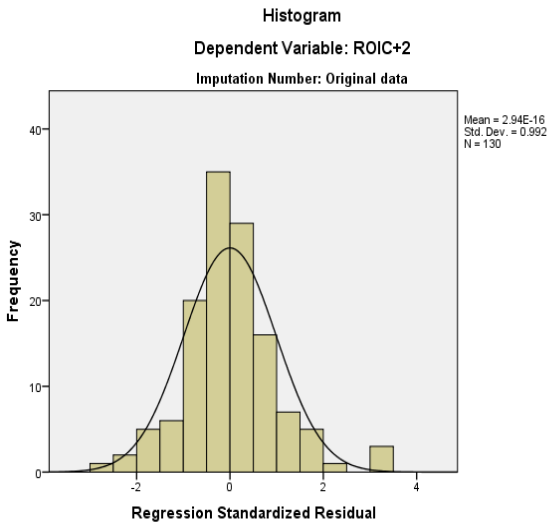
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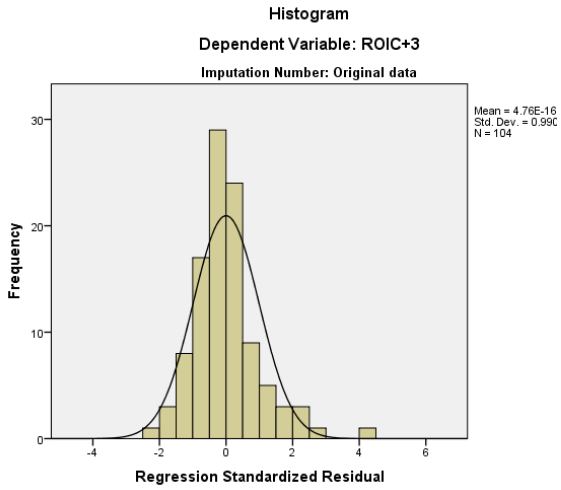
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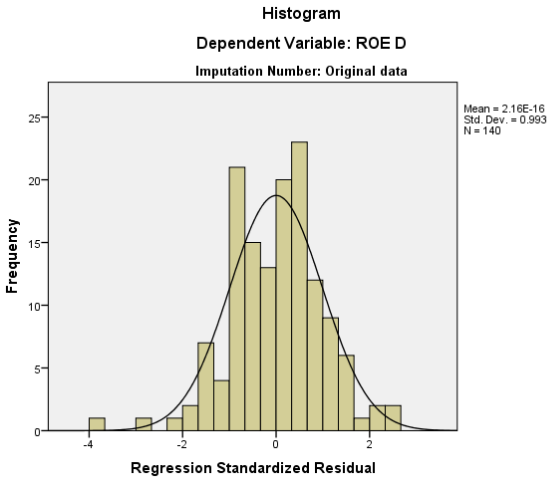
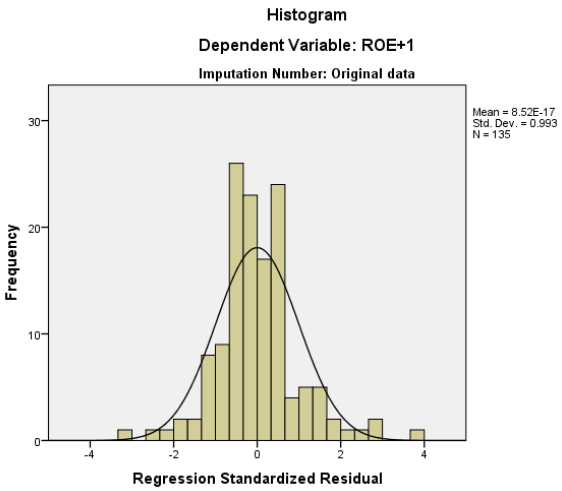
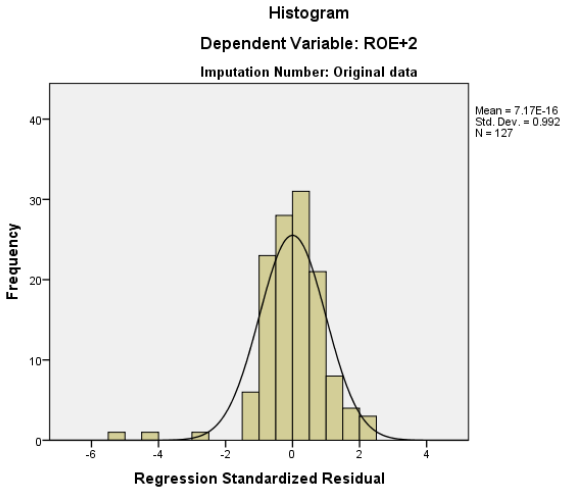
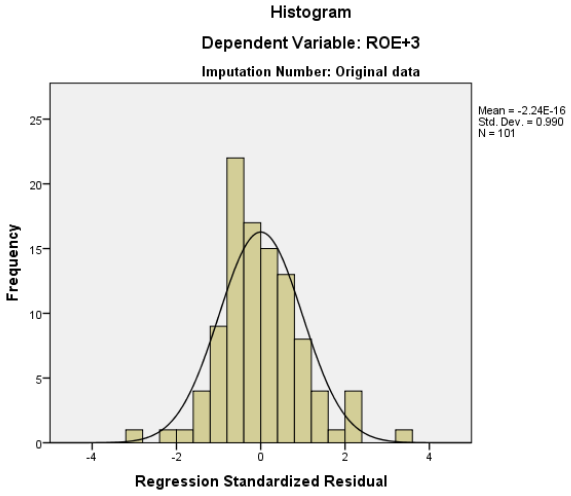
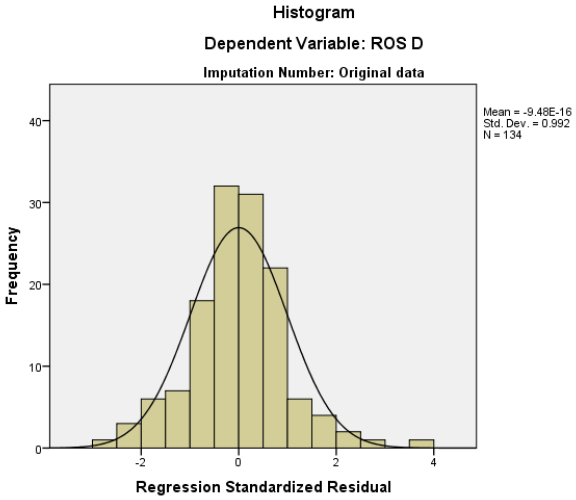
Frequency
Regression Standardized Residual

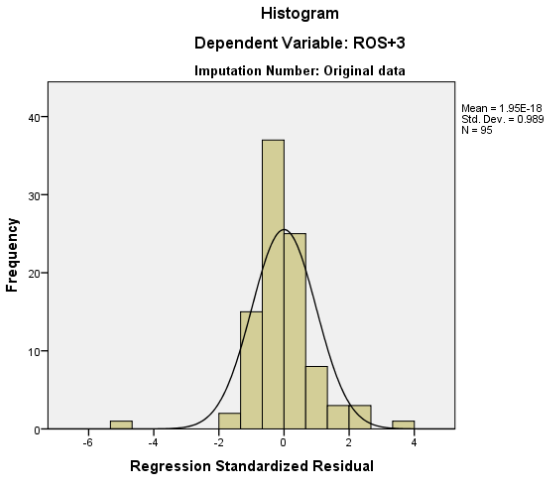

Histogram
Dependent Variable: ROE D
Imputation Number: Original data
Mean = 2.16E-16
Std. Dev. = 0.993
N = 140
Frequency
Regression Standardized Residual

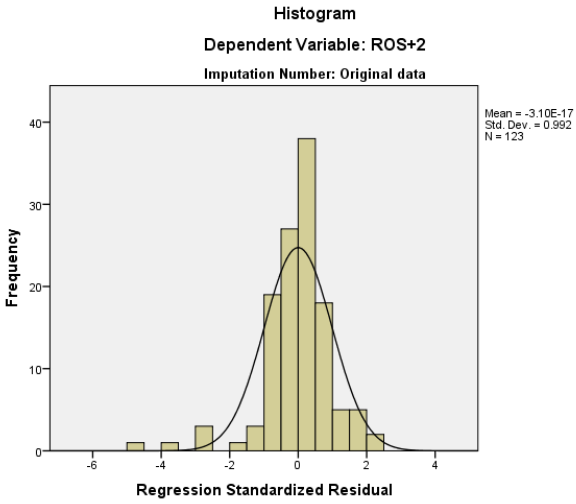

Histogram
Dependent Variable: ROE+1
Imputation Number: Original data
Mean = 8.52E-17
Std. Dev. = 0.993
N = 135
Frequency
Regression Standardized Residual

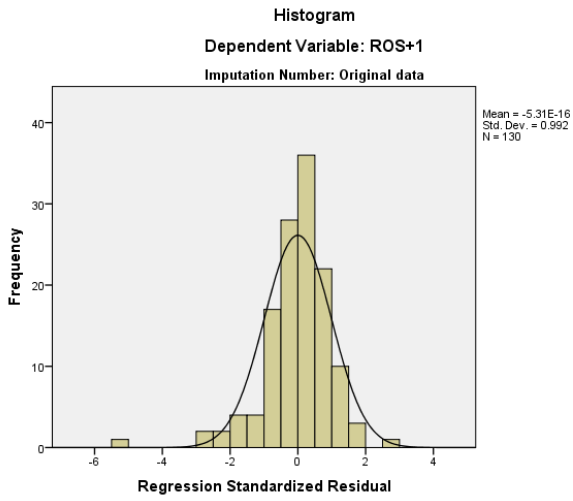

Histogram
Dependent Variable: ROE+2
Imputation Number: Original data
Mean = 7.17E-16
Std. Dev. = 0.992
N = 127
Frequency
Regression Standardized Residual

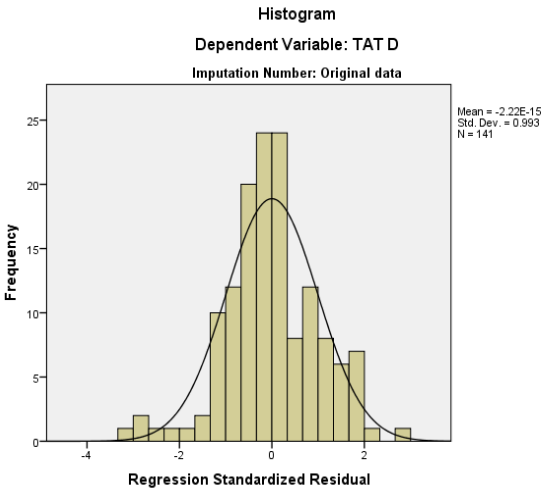

Histogram
Dependent Variable: ROE+3
Imputation Number: Original data
Mean = -2.24E-16
Std. Dev. = 0.990
N = 101
Frequency
Regression Standardized Residual

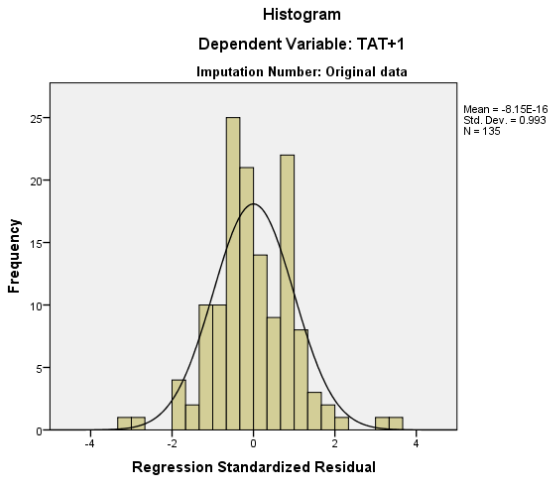

Histogram
Dependent Variable: ROS D
Imputation Number: Original data
Mean = -9.48E-16
Std. Dev. = 0.992
N = 134
Frequency
Regression Standardized Residual

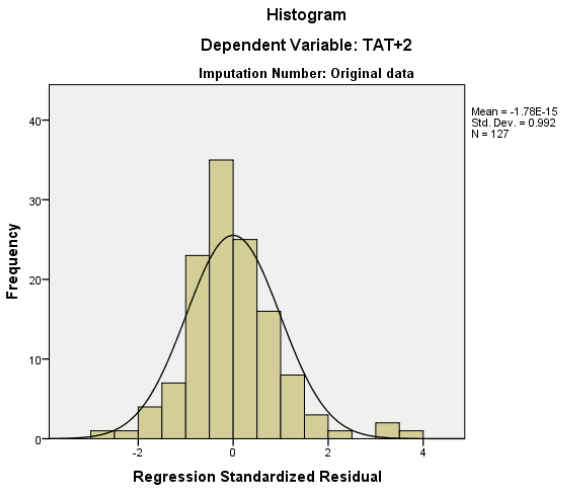

Histogram
Dependent Variable: ROS+3
Imputation Number: Original data
Mean = 1.95E-18
Std. Dev. = 0.989
N = 95
Frequency
Regression Standardized Residual

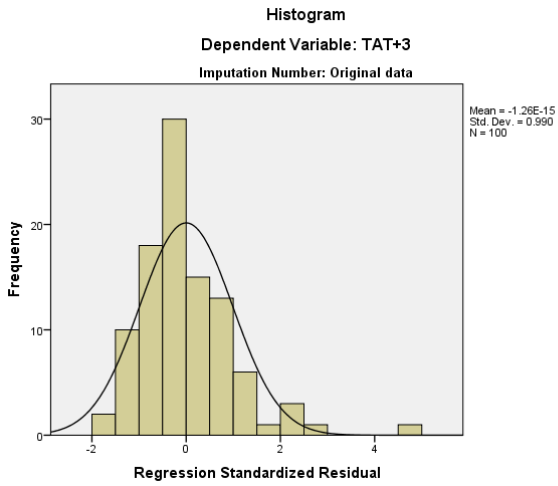

Histogram
Dependent Variable: ROS+2
Imputation Number: Original data
Mean = -3.10E-17
Std. Dev. = 0.992
N = 123
Frequency
Regression Standardized Residual

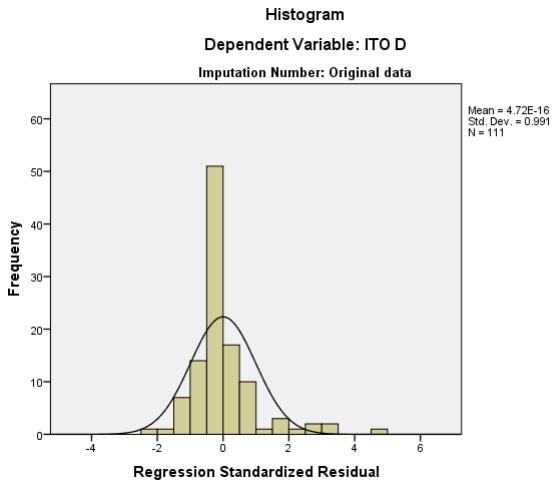

Histogram
Dependent Variable: ROS+1
Imputation Number: Original data
Mean = -5.31E-16
Std. Dev. = 0.992
N = 130
Frequency
Regression Standardized Residual

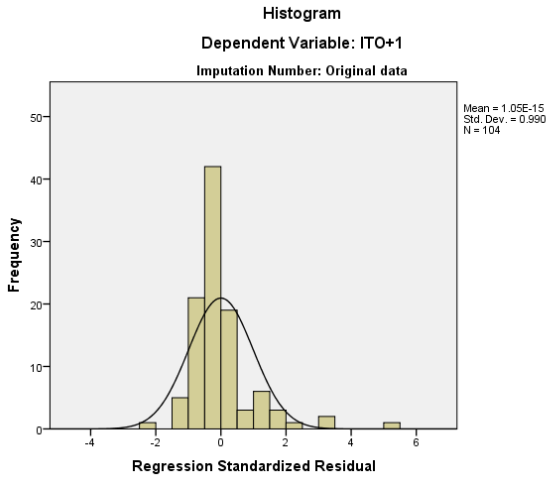

Histogram
Dependent Variable: TAT D
Imputation Number: Original data
Mean = -2.22E-15
Std. Dev. = 0.993
N = 141
Frequency
Regression Standardized Residual

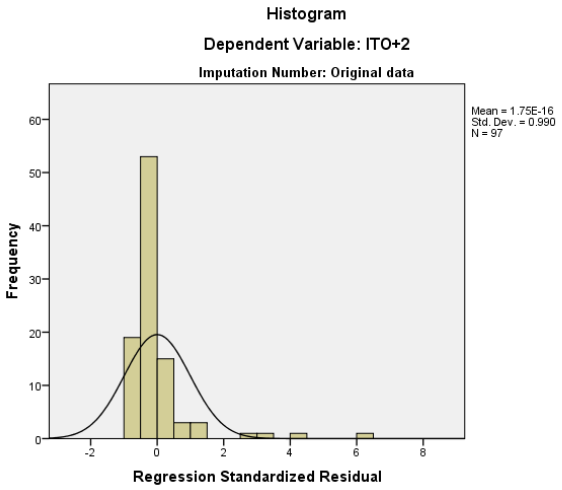

Histogram
Dependent Variable: TAT+1
Imputation Number: Original data
Mean = -8.15E-16
Std. Dev. = 0.993
N = 135
Frequency
Regression Standardized Residual

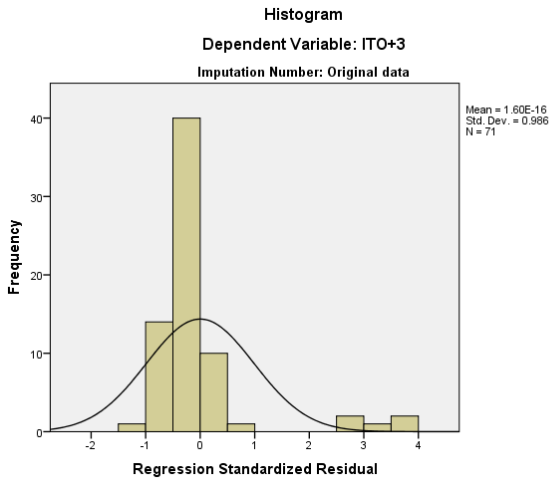

Histogram
Dependent Variable: TAT+2
Imputation Number: Original data
Mean = -1.78E-15
Std. Dev. = 0.992
N = 127
Frequency
Regression Standardized Residual

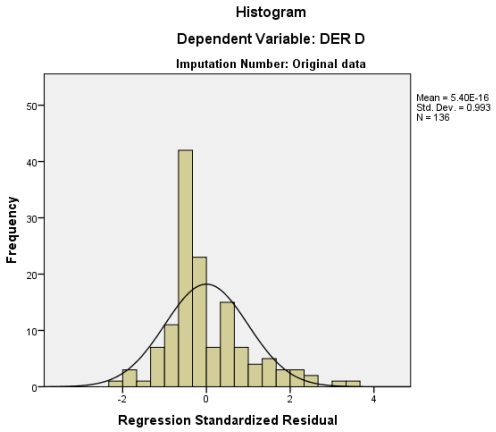

Histogram
Dependent Variable: TAT+3
Imputation Number: Original data
Mean = -1.26E-15
Std. Dev. = 0.990
N = 100
Frequency
Regression Standardized Residual

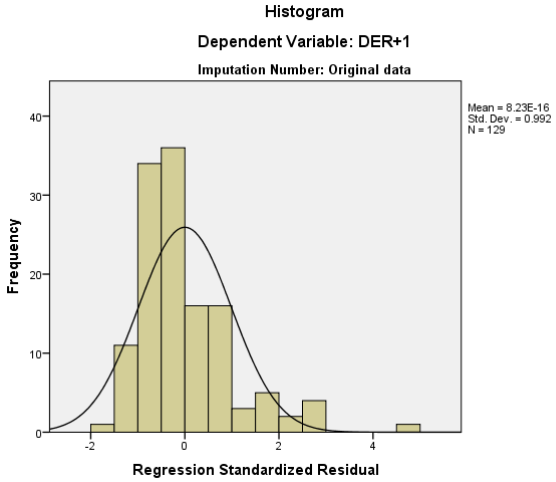

Histogram
Dependent Variable: ITO D
Imputation Number: Original data
Mean = 4.72E-16
Std. Dev. = 0.991
N = 111
Frequency
Regression Standardized Residual

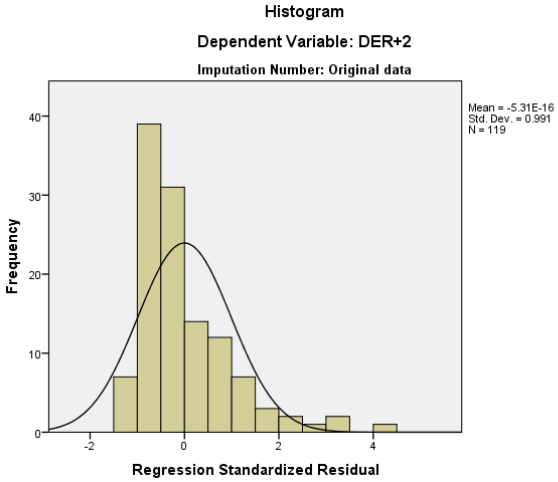

Histogram
Dependent Variable: ITO+1
Imputation Number: Original data
Mean = 1.05E-15
Std. Dev. = 0.990
N = 104
Frequency
Regression Standardized Residual

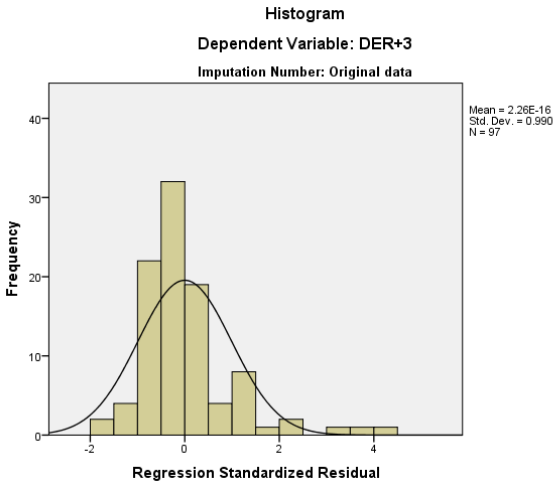

Histogram
Dependent Variable: ITO+2
Imputation Number: Original data
Mean = 1.75E-16
Std. Dev. = 0.990
N = 97
Frequency
Regression Standardized Residual

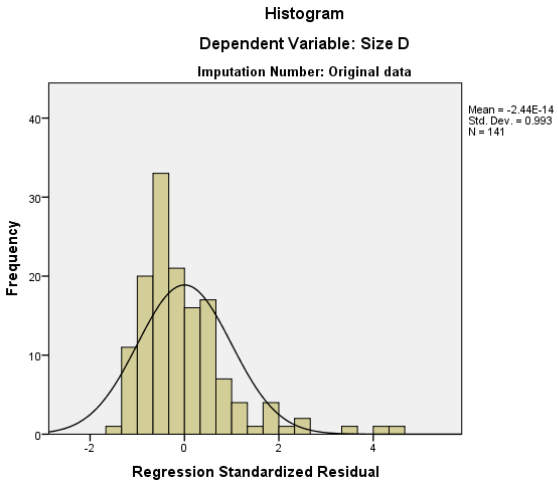

Histogram
Dependent Variable: ITO+3
Imputation Number: Original data
Mean = 1.60E-16
Std. Dev. = 0.986
N = 71
Frequency
Regression Standardized Residual

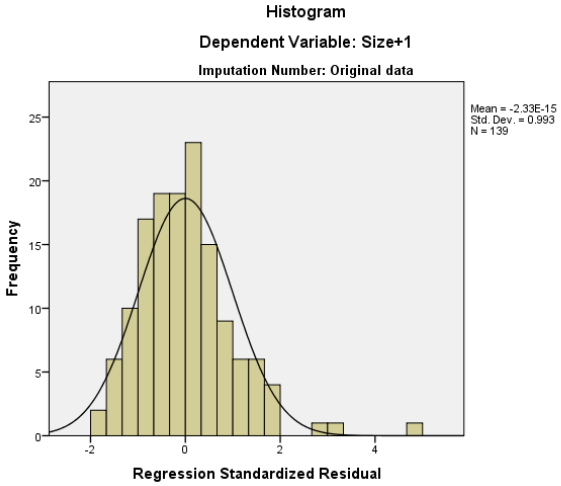

Histogram
Dependent Variable: DER D
Imputation Number: Original data
Mean = 5.40E-16
Std. Dev. = 0.993
N = 136
Frequency
Regression Standardized Residual

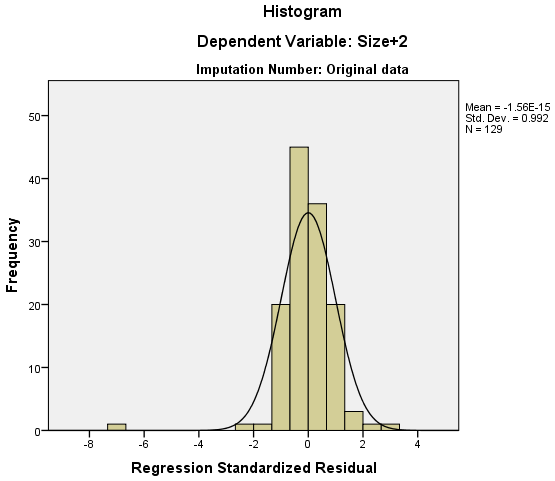

Histogram
Dependent Variable: DER+1
Imputation Number: Original data
Mean = 8.23E-16
Std. Dev. = 0.992
N = 129
Frequency
Regression Standardized Residual

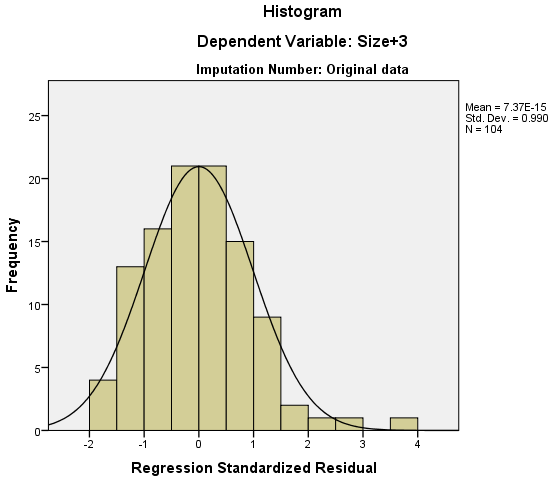

Histogram
Dependent Variable: DER+2
Imputation Number: Original data
Mean = -5.31E-16
Std. Dev. = 0.991
N = 119
Frequency
Regression Standardized Residual

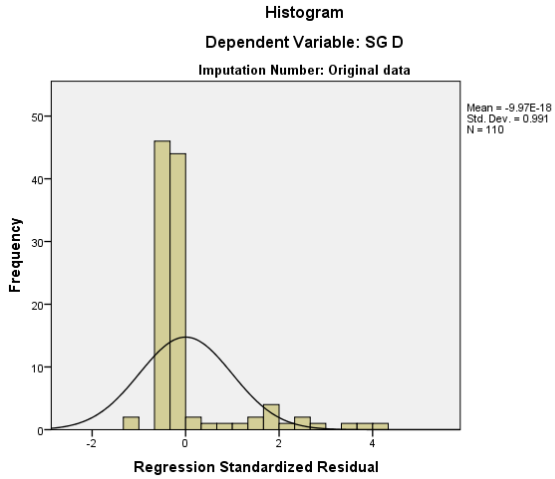

Histogram
Dependent Variable: DER+3
Imputation Number: Original data
Mean = 2.26E-16
Std. Dev. = 0.990
N = 97
Frequency
Regression Standardized Residual

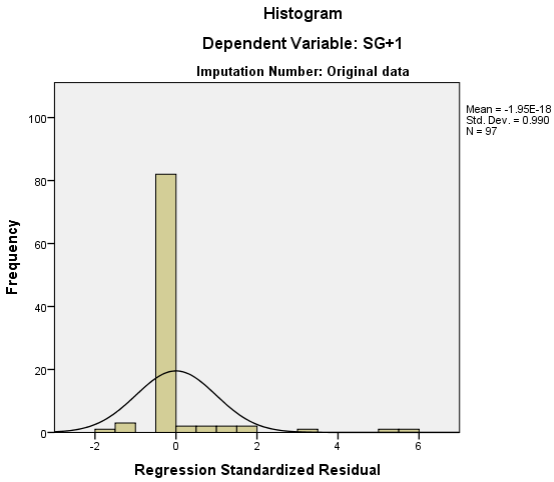

Histogram
Dependent Variable: Size D
Imputation Number: Original data
Mean = -2.44E-14
Std. Dev. = 0.993
N = 141
Frequency
Regression Standardized Residual

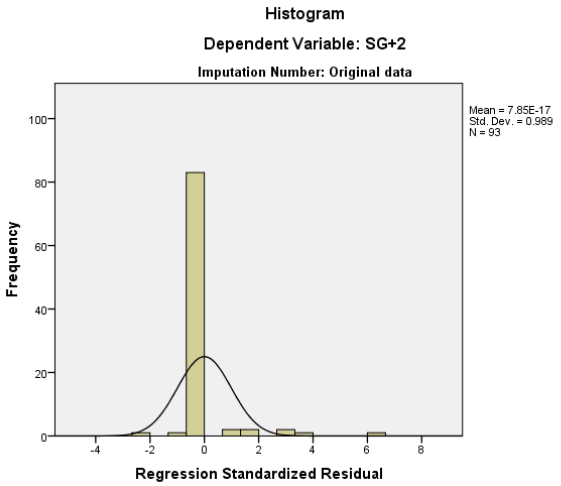

Histogram
Dependent Variable: Size+1
Imputation Number: Original data
Mean = -2.33E-15
Std. Dev. = 0.993
N = 139
Frequency
Regression Standardized Residual

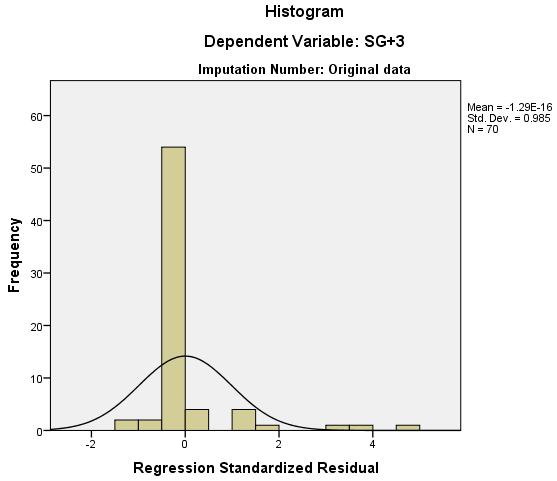

Histogram
Dependent Variable: Size+2
Imputation Number: Original data
Mean = -1.56E-15
Std. Dev. = 0.992
N = 129
Frequency
Regression Standardized Residual

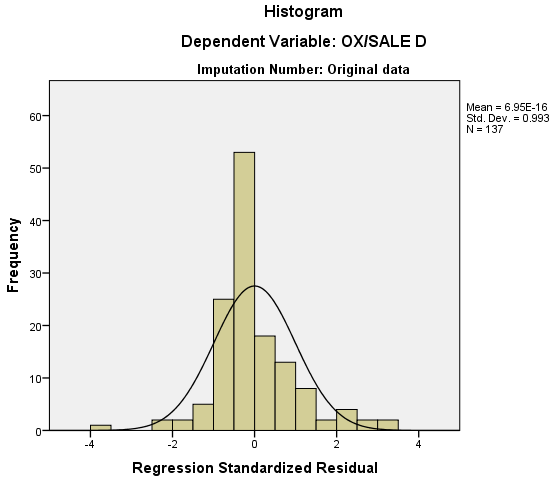

Histogram
Dependent Variable: Size+3
Imputation Number: Original data
Mean = 7.37E-15
Std. Dev. = 0.990
N = 104
Frequency
Regression Standardized Residual

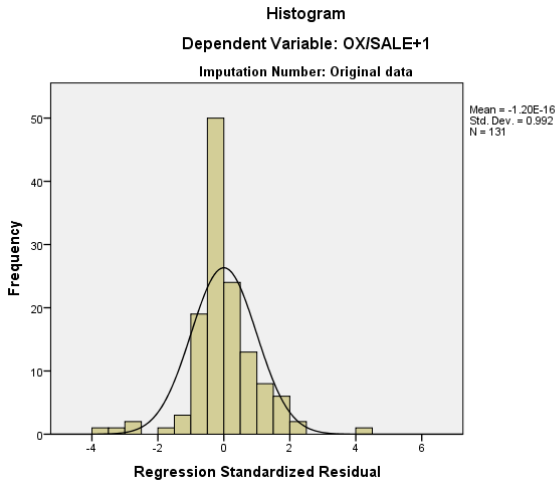

Histogram
Dependent Variable: SG D
Imputation Number: Original data
Mean = -9.97E-18
Std. Dev. = 0.991
N = 110
Frequency
Regression Standardized Residual

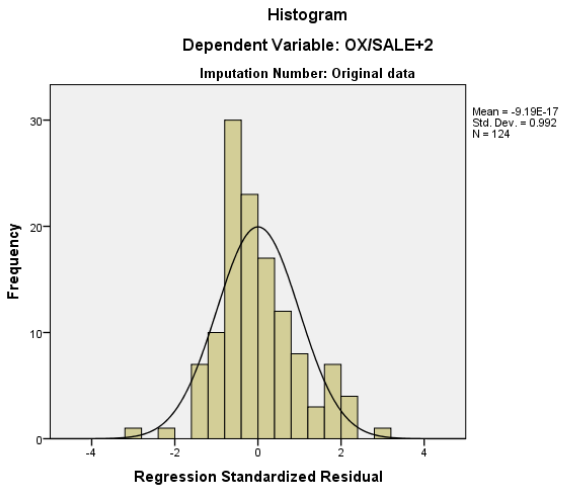

Histogram
Dependent Variable: SG+1
Imputation Number: Original data
Mean = -1.95E-18
Std. Dev. = 0.990
N = 97
Frequency
Regression Standardized Residual

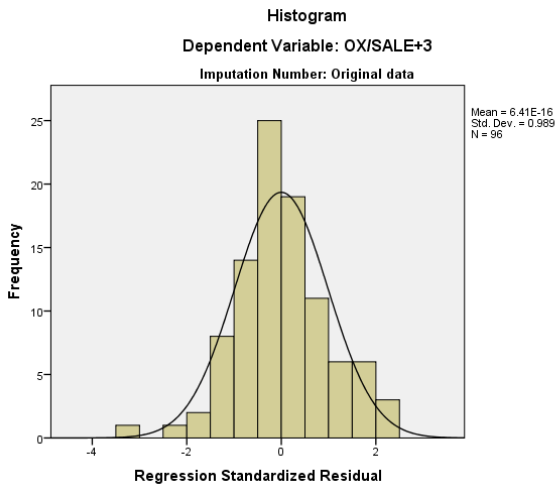

Histogram
Dependent Variable: SG+2
Imputation Number: Original data
Mean = 7.85E-17
Std. Dev. = 0.989
N = 93
Frequency
Regression Standardized Residual

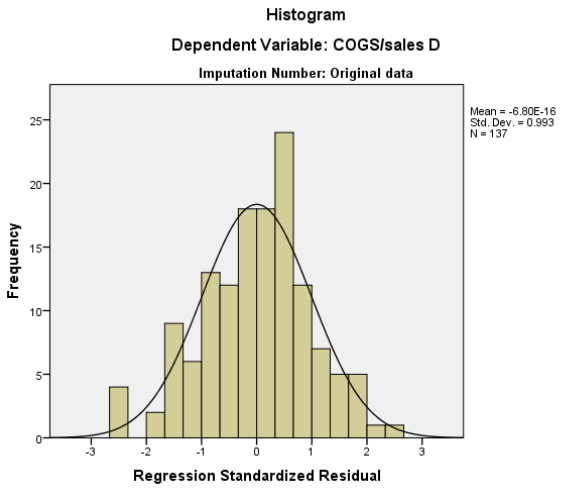

Histogram
Dependent Variable: SG+3
Imputation Number: Original data
Mean = -1.29E-16
Std. Dev. = 0.985
N = 70
Frequency
Regression Standardized Residual

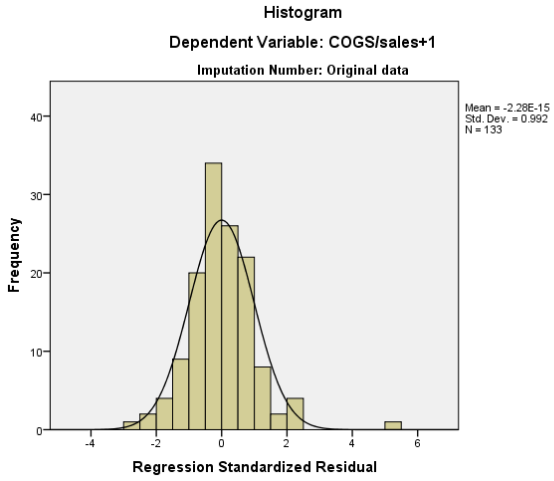

Histogram
Dependent Variable: OX/SALE D
Imputation Number: Original data
Mean = 6.95E-16
Std. Dev. = 0.993
N = 137
Frequency
Regression Standardized Residual

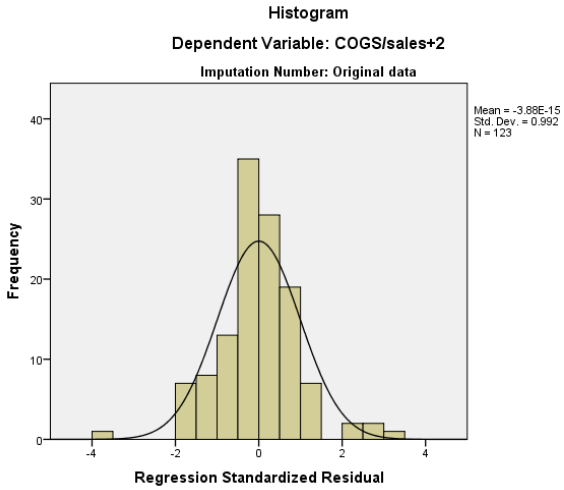

Histogram
Dependent Variable: OX/SALE+1
Imputation Number: Original data
Mean = -1.20E-16
Std. Dev. = 0.992
N = 131
Frequency
Regression Standardized Residual

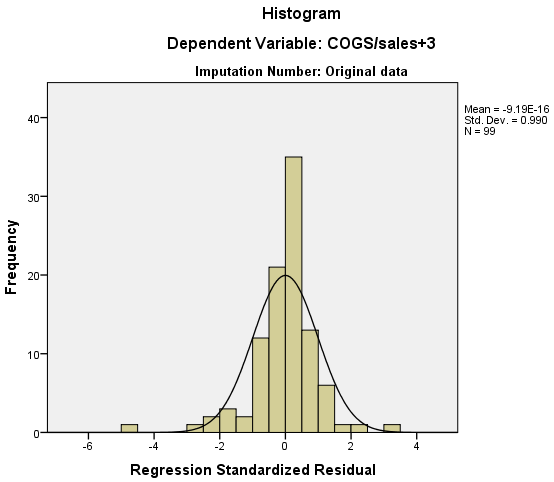

Histogram
Dependent Variable: OX/SALE+2
Imputation Number: Original data
Mean = -9.19E-17
Std. Dev. = 0.992
N = 124
Frequency
Regression Standardized Residual


Histogram
Dependent Variable: OX/SALE+3
Imputation Number: Original data
Mean = 6.41E-16
Std. Dev. = 0.989
N = 96
Frequency
Regression Standardized Residual


Histogram
Dependent Variable: COGS/sales D
Imputation Number: Original data
Mean = -6.80E-16
Std. Dev. = 0.993
N = 137
Frequency
Regression Standardized Residual


Histogram
Dependent Variable: COGS/sales+1
Imputation Number: Original data
Mean = -2.28E-15
Std. Dev. = 0.992
N = 133
Frequency
Regression Standardized Residual


Histogram
Dependent Variable: COGS/sales+2
Imputation Number: Original data
Mean = -3.88E-15
Std. Dev. = 0.992
N = 123
Frequency
Regression Standardized Residual


Histogram
Dependent Variable: COGS/sales+3
Imputation Number: Original data
Mean = -9.19E-16
Std. Dev. = 0.990
N = 99
Frequency
Regression Standardized Residual

Appendix B

Results based on regression analysis

Variable	Model Name	Parameter estimates (Standard error in brackets) ROA	ROIC	ROE	ROS	TAT
Constant	X1	0.037(0.014)***	0.088(0.02)***	0.093(0.022)***	0.004(0.008)***	0.542(0.08)***
During	X2	0.022(0.013)*	-0.00(0.014)	0.006(0.018)	-0.014(0.006)	0.199(0.046)***
1YA	X3	0.031(0.014)**	0.033(0.018)*	0.039(0.23)*	-0.002(0.008)	0.312(0.064)***
2YA	X4	0.035(0.015)***	0.039(0.019)**	0.041(0.25)*	-0.001(0.009)	0.424(0.075)***
3YA	X5	0.044(0.016)***	0.068(0.021)***	0.061(0.27)**	0.002(0.01)	0.542(0.089)***
Lag	X6	0.39(0.03)***	0.481(0.021)***	0.474(0.021)***	0.396(0.033)***	0.376(0.026)***
Adjusted R square		0.742	0.746	0.677	0.802	0.881

		ITO	DER	SZ	OX	SG	COGS
Constant	X1	6.015(0.896)***	0.611(0.166)***	2.162(0.288)***	0.039(0.007)***	-0.095(0.252)	0.259(0.045)
During	X2	0.289(0.764)	0.079(0.1)	0.516(0.041)***	0.007(0.005)	0.022(0.238)	0.007(0.008)
1YA	X3	-0.17(1.225)	0.99(0.133)	0.984(0.074)***	-0.011(0.007)*	0.429(0.275)	0.014(0.014)
2YA	X4	-0.327(1.489)	0.136(0.149)	0.983(0.096)***	-0.009(0.008)	0.312(0.283)	0.013(0.018)
3YA	X5	-1.11(1.79)	0.041(0.17)	1.169(0.119)***	-0.016(0.009)*	0.399(0.317)	0.016(0.023)
Lag	X6	0.335(0.029)***	0.504(0.039)***	0.762(0.029)***	0.615(0.031)***	0.806(0.030)***	0.662(0.041)***
Adjusted R square		0.787	0.772	0.990	0.844	0.996	0.961

*** If the p-value < 0.01, ** if the p-value < 0.05 and * if the p-value < 0.1,

Appendix C

Evaluating fina Form Title

1. Please fill in below the name of your institution and contact. It is ensured that the name of your company will be kept confidential

2. Has your company/institution (within geographic location of Pakistan/Netherlands) implemented/purchased Enterprise Resource Planning(Single select question)

- Yes
- No (if no please go to question no.13)

3. Please tell us which of following your institution has implemented?(Single select question)

- A complete ERP suite
- Module(s) of ERP

4. Who was the vendor of your ERP and ERP product(s) your institution has implemented?(Multiple select question)

- Microsoft Dynamics AX (an accounting and finance, HR and CRM tool)
- Microsoft Dynamics GP (a mid-market accounting suite)
- Microsoft Dynamics NAV (SME ERP platform)
- Microsoft Dynamics SL (SME ERP platform)
- Oracle CRM
- Oracle Financials
- Oracle Logistics
- Oracle Order Management
- Oracle Warehouse Management Systems
- SAGE CRM
- SAGE HR
- SAGE Business Intelligence
- SAGE Payroll
- SAP Business One ERP Complete
- SAP Business One Accounts Payable
- SAP Business One Accounts Receivable

- ☐ SAP Business One Accounting and Financial Reporting
- ☐ SAP Business One Risk Management
- ☐ SAP Business One Regulatory Compliance
- ☐ SAP Business One Cash Flow Monitoring
- ☐ SAP Business One Travel Management
- ☐ SAP Business One End-User Maintenance
- ☐ SAP Business One HR and Payroll
- ☐ SAP Business One HR Process Management Software
- ☐ SAP Business One HR Reporting
- ☐ SAP Business One Labor Force Analysis
- ☐ SAP Business One Job placement
- ☐ SAP Business One Recruitment and Training
- ☐ SAP Business One Talent Management
- ☐ SAP Business One Procurement and logistics
- ☐ SAP Business One Product development and manufacturing
- ☐ SAP Business One Sales and service
- ☐ SAP Operation analytics
- ☐ Infor Global Solution Complete
- ☐ Infor ERP LN
- ☐ Infor ERP SyteLine
- ☐ Infor ERP VISUAL
- ☐ Infor ERP Adage
- ☐ Infor ERP LX
- ☐ NetERP from Net Suite Complete
- ☐ NetERP Accounting
- ☐ NetERP CRM
- ☐ NetERP e-commerce
- ☐ NetERP website development software
- ☐ Lawson S3 (broadly for service firms)
- ☐ Lawson M3 (broadly for manufacturing and distributors)
- ☐ Legacy system
- ☐ No enterprise software in use

- Other:

5. In what year did your institution start its planning to purchase and implement the ERP product(s)? please specify the year from 1995 to 2013.

6. In what year did your institution purchase ERP product(s)? Please specify the year from 1995 to 2013.

7. When did the first module of your ERP system go live? Please specify (mm/yyyy).

8. Which of following cost items did your institution include in original ERP budget when making purchase decision?(Multiple select question)

- Hardware (Technical specific)
- Software (Technical specific)
- Database (Technical specific)
- Operating system (Technical specific)
- Interfaces (Technical specific)
- Customization (Technical specific)
- System validation (in regulated industries) (Technical specific)
- Network and technical communication (Technical specific)
- Maintenance and support (Technical Specific)
- Hosting (Technical specific)
- Other(s) (Technical specific)
- Education (People specific)
- Training (People specific)
- Project Management (People specific)
- Change Management (People specific)
- External consultancy support (People specific)
- Back-filling for internal project team members (People specific)
- Others (People specific)
- Extraction from the legacy systems (Data migration specific)
- Cleansing and accuracy (Data migration specific)
- Entry into new system (Data migration specific)
- Others (Data migration specific)

9. What was original budget for ERP implementation at the time of making purchase decision? Please specify the amount and currency?

- Between 10 to 15 million PKR
- Between 15 to 20 million PKR
- Between 20 to 25 million PKR
- Less than 10 million PKR
- More than 25 million PKR
- Other:

10. Did your institution complete ERP implementation within original budget?(Single select question)

- On budget
- Under budget
- Over budget by up to 50%
- Over budget from 50% to 100%
- Over budget by more than 100%

11. What was the reason(s) of project over budget?(Multiple select question)

- Project budget was unrealistic
- Initial project scope was expanded
- Additional technology needed to be purchased to meet project goals
- Project staffing was underestimated in the budget
- Unanticipated technical or organizational issues caused additional costs
- Consulting fee rose as the project schedule slipped
- Other:

12. What was average annual budget for the first five years after ERP going live?

- 10% of actual amount spent on ERP until going alive
- 20% of actual amount spent on ERP until going alive
- 30% of actual amount spent on ERP until going alive
- 40% of actual amount spent on ERP until going alive
- 50% of actual amount spent on ERP until going alive
- Other:

13. If you have decided not to implement packaged ERP software for one or more of your enterprise systems, Why not?(Multiple select question)

- Our legacy system works
- We have a staged implementation strategy
- Didn't see the value

- The ERP solutions on the market did not seem to be a fit with out institution's need
- The experience of others raised red flags
- The institution had other priorities
- We were not ready—we had no collective agreement, and therefore, no plan to move forward
- Unable to secure approval from senior management and/or the Board of Trustees
- Wanted to wait for the product to mature
- Want to wait for product to come down in price
- Other:

14. Please give the estimated average annual cost (for five years) that your institution spent on legacy system before ERP implementation. If your ERP went live in 2001 for example, the average annual cost of legacy system must be average annual cost from 2000, 1999 etc (in descending order).

- Between 1 to 2 million PKR
- Between 2 to 3 million PKR
- Between 3 to 4 million PKR
- Less than 1 million PKR
- Greater than 4 million PKR
- Other:

Add item